FIG. 6.

Cancer of sigmoid with acute ileus treated by cæcostomy followed
by Mikulicz two-stage resection using local anæsthesia.

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INTERNATIONAL CLINICS

A QUARTERLY

OF

ILLUSTRATED CLINICAL LECTURES AND
ESPECIALLY PREPARED ORIGINAL ARTICLES

ON

TREATMENT, MEDICINE, SURGERY, NEUROLOGY, PÆDIAT-
RICS, OBSTETRICS, GYNÆCOLOGY, ORTHOPÆDICS,
PATHOLOGY, DERMATOLOGY, OPHTHALMOLOGY,
OTOLOGY, RHINOLOGY, LARYNGOLOGY,
HYGIENE, AND OTHER TOPICS OF INTEREST
TO STUDENTS AND PRACTITIONERS

BY LEADING MEMBERS OF THE MEDICAL PROFESSION
THROUGHOUT THE WORLD

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(THIRTIETH SERIES)

of paratyphoid fever. There is no history suggesting acute cholecystitis at this time. Five years ago he had an acute attack of very severe pain in the epigastrium which lasted about twenty-four hours. He does not remember much of the details, but is positive that there was no vomiting during the attack and that jaundice did not follow it. He has always had some trouble with constipation. There is no history of any urinary disease and he denies gonococcus infection and syphilis. He has used alcohol very moderately. He has always regarded himself as being an exceptionally strong man. There has not been any change in weight. His occupation is entirely executive and he does not handle lead in any form.

Present Illness.—The onset was yesterday, on the day of admission to the hospital. He states that he got up at his usual hour feeling perfectly well, took his ordinary simple breakfast and had been attending to his business all morning. About 1 P.M., while standing on the street talking to a friend he felt a sudden burning sensation which he indicates as situated in the centre of the abdomen, occupying a circular space about six inches in diameter with the navel as the centre. Almost immediately after this there was intense severe abdominal pain which he states was in the epigastrium. He thought that he was dying, had difficulty in standing and broke into a very profuse sweat. He was only a short distance from the office of a friend, and with assistance he was able to reach it. His serious condition was recognized and the hospital ambulance was sent for at once. As he was only a short distance from the hospital, he was admitted within about twenty minutes of the onset. On admission it was evident that his condition was critical.

Dr. McCrae: It is always well to consider the history carefully and see what conditions are suggested by it. This does not mean that we make a diagnosis from the history, but the more possibilities that are suggested by it, the less the chance of failing to consider the proper one. Mr. A., what points in the past history would you specially comment on?

Student: The attack of abdominal pain five years ago which seems to have been of short duration.

Dr. McCrae: It does not seem possible to give any definite opinion as to the nature of this attack. He was not jaundiced after it, so far as known. We can only speculate as to whether it was due to the same

cause as the present illness. There is one other point which should be noted—that he had an attack of paratyphoid fever eight years ago. He was told this in the hospital where he was and we can probably accept it as correct. What possible bearing may this have?

Student: That he has some gall-bladder trouble as a result.

Dr. McCrae: In the history which he gives of the onset of the illness you will note the suddenness which characterized it. One minute he was talking business and the next he thought he was dying. When brought to the hospital a few minutes later he seemed so ill that it was thought he might die very soon. The problem, then, is the explanation of this sudden onset of severe pain with signs of shock in a man aged fifty. Before we take up the condition of the patient, let us discuss some of the possibilities which are suggested by the history. Mr. B, what would you suggest?

Student: Rupture of a gastric ulcer.

Dr. McCrae: Anything else?

Student: Rupture of an aneurism, gall-stone colic, intestinal obstruction or angina pectoris.

Dr. McCrae: These are all possibilities. Mr. A, have you anything to add?

Student: A gastric crisis in tabes, acute pancreatitis, and an attack of lead colic.

Dr. McCrae: Are there any more suggestions? If not we will go on with the examination of the present condition, but first we will have the note of his state on admission yesterday.

Examination.—The patient is very well nourished. He is seriously ill and suffering intense abdominal pain, which causes him to writhe about in bed. He is in a condition of shock with sweating; the extremities are cold. He complains of numbness in the hands and feet. There is a question as to whether the sclerotics show jaundice and the color is best described as icteroid. Examination of the head and mouth is otherwise negative. The lungs are clear. The heart shows a very feeble impulse, and no evidence of cardiac enlargement is found. The heart sounds are distant and feeble, the pulse is 66 and rather small in volume but quite regular. The abdomen is somewhat distended. The patient points to the epigastric and umbilical regions as the seat of the pain. There is very slight abdominal tenderness on palpation which seems most marked about the

navel. The contrast between the severe pain and the absence of rigidity and any marked tenderness is striking. No mass can be felt and despite the distension it is possible to palpate as satisfactorily as one ever can when abdominal walls are thick. The sounds of peristalsis are well heard. When pressure is made over the lower costal region on the right side the patient states that he feels more comfortable. The leucocytes are 13,400. Soon after admission he began to vomit. There was no blood in the vomitus but a considerable quantity of bile. Not long after this there was a free movement of the bowels.

The diagnosis is in doubt. The circulation shows so much disturbance that the possibility of thrombosis of a coronary artery has to be strongly considered, as well as an acute abdominal condition. The possibility of acute pancreatitis is to be kept in mind. The whole picture is one of shock.

He was kept warm; heat was applied to the abdomen and morphia given to control the pain. These gave him relief and he had a fairly comfortable night. The bowels have moved, and he has expelled gas on several occasions. There has not been any further vomiting. We will now see what the condition is about twenty-four hours after the onset.

Examination Before the Clinic.—The patient is well nourished and has a fairly good color. He does not show any evidence of severe pain, but states that he is not entirely comfortable, and knows that there is " something wrong in the abdomen." It is important to remember that he has had some morphia hypodermically. He has not vomited since shortly after admission. The condition of the circulation is much improved, and the heart sounds are of better quality. The abdomen shows some distension and distinctly more tenderness than was evident on admission. There is now slight rigidity, which is not by any means marked, and is more evident in the upper abdomen than below. On fairly deep pressure there is slight muscle spasm over the upper part of both recti muscles. It is particularly important to note that his pulse is 72, of good volume, and regular. The systolic pressure is 120 and the diastolic is 70. The leucocytes to-day are 10,400. Examination of the vomitus showed a total acidity of 7, no free HCl, a considerable quantity of bile, but no blood. The urine shows a faint trace of albumin, but is otherwise normal. Perhaps the most striking change since admission

is in the improvement in his circulation and the disappearance of the signs of shock.

Now let us discuss the possibilities as far as we can. In doing this it is well to make first the most general division. This can be of conditions above and below the diaphragm. You may perhaps think that there should be no difficulty in this and that it is easy to decide whether disease is of organs above or below the diaphragm. Each one of you will learn the contrary by experience. One difficulty which has arisen in this connection is in the diagnosis between angina pectoris and gall-stone colic. This is particularly the case if, as sometimes happens, there is jaundice with the angina. You can find the notes of three such cases given by Sir William Osler [1] in the Lumleian Lectures of 1910. One of those patients had been operated on by Mayo Robson, but gall-stones were not found. If these were cases of angina pectoris, and there seems no reason to doubt the diagnosis, it is difficult to explain the occurrence of jaundice.

As to conditions above the diaphragm, angina pectoris has been suggested. This could hardly be the usual variety, at any rate with the customary distribution of the pain, but there is a form termed *angina abdominis* which should be considered. Frankly, I am not very clear in my own mind what it really represents. Several conditions are probably included under this designation. (1) There seems no doubt that in some cases with a thoracic lesion the pain of angina pectoris is referred to the epigastrium. In some instances the attacks of pain have alternated between the thorax and epigastrium and in others the pain, at first in the abdomen, has later been felt in the thorax. (2) Disease of the abdominal aorta or the large branches may cause severe pain. There is no more difficulty in understanding this than in the thoracic form. (3) Thrombosis or embolism of the coronary arteries may be accompanied by severe epigastric pain. Any one of these may be the explanation of the cases of sudden death described so often in the public press as due to " acute indigestion." You will find an interesting discussion of abdominal angina in that storehouse of information regarding diseases of the arteries, Sir Clifford Allbutt's work.[2]

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[1] *Lancet*, 1910, i. p. 701.

[2] " Diseases of the Arteries, including Angina Pectoris," by Sir Clifford Allbutt, Vol. 11, p. 304, *et. seq.*

When I first saw the patient, the diagnosis of coronary thrombosis or embolism seemed strongly suggested, but the condition of his circulation improved so rapidly and is so good to-day that it does not seem possible. The picture was not that of angina pectoris. The patient who has that does not throw himself about the bed. Therefore, the chance of this attack being due to conditions above the diaphragm seems unlikely. Of conditions below the diaphragm there are more to be considered. Let us discuss those which have been suggested.

1. *Rupture of a Gastric Ulcer.*—This has to be kept prominently in mind, but the evidence seems strongly against it. If it has happened, the rupture was evidently into the lesser peritoneum, and this may not be easy to exclude. One point seems important—the absence of any respiratory embarrassment, which is usually present if the lesser peritoneum is involved in an inflammatory process. The abdominal examination is also against it, especially the absence of any marked rigidity, and we have not hesitated to let him have food which he has taken without any discomfort.

2. *Rupture of an Aneurism.*—This has to be considered, especially of an aneurism of the abdominal artery or cœliac axis. There is no evidence of the presence of an aneurism of either of these vessels, and he is not likely to have recovered so quickly, at any rate from a rupture of any extent. The pulse is equal in the femoral arteries and synchronous with that in the radials. There is no murmur heard on auscultation over the abdomen. The results of the Wassermann reaction should be of help in deciding as to the chances of aneurism.

3. *Gall-Stone Colic.*—This seems a perfectly possible and even probable diagnosis. He had paratyphoid fever eight years ago. At present the tenderness is more in the epigastrium, and there is very little over the region of the gall-bladder, but this does not exclude gall-stone colic. In addition, it seems possible to say to-day that he has slight jaundice, which is suggestive. The yellow tinge to the sclerotics is more marked than it was on admission.

4. *Acute Pancreatitis.*—This should be considered in every case of acute onset of severe abdominal pain, especially with signs of shock. If this is the explanation, we can say that the attack has not been of maximum severity—he would not be so well to-day if it had been.

I do not see that we can definitely exclude pancreatitis, but the absence of a marked leucocytosis is against it.

5. *Lead Colic.*—He is very sure that he does not handle lead in his work; there is no lead line on the gums and no lead granulation in the red cells. It would seem that we can exclude this.

6. *Intestinal Obstruction.*—The fact that his bowels have moved freely without any purgative or enema, the frequent passage of flatus and the absence of any increase in the abdominal distension are against this. At no time has this seemed a probability.

7. *A Gastric Crisis.*—The pupils are equal and react well to light. The knee jerks are present. The possibility of tabes seems excluded.

To sum up, the most likely possibilities to-day seem to be gall-bladder disease probably with gall-stones and acute pancreatitis. The two conditions may occur together. One question is evident—should we advise operation? This is a nice decision to make. For some time after admission his condition was so serious that operation was out of the question. In the interval he is better and seems to be improving, so that it seems wise to wait, in which decision my surgical colleague agrees. The patient requires an occasional dose of morphia to relieve the pain, but we are not giving him enough to obscure the symptoms and signs.

Three days later (fifth day of disease) the problem was again discussed.

Dr. McCrae: Mr. A, will you report the progress since the patient was shown before?

Student: The general condition is improved, but the temperature has been higher with the pulse rate almost normal. There is little or no abdominal distention and the pain is now referred to the upper epigastrium and the region of the gall-bladder. The tenderness is in the same region, but is not marked over the gall-bladder. There is now perfectly *distinct jaundice.* The daily leucocyte counts have been 13,000, 10,400, 16,000 and 13,600. The Wassermann reaction is negative. The urine shows a faint trace of albumin and some hyaline casts. The stools have not shown the presence of blood, either gross or occult, and there is no evidence of any disturbance of fat digestion. The bowels have moved regularly.

Dr. McCrae: How do these findings influence your opinion of the diagnosis?

Student: They are against intestinal obstruction and acute pancreatitis.

Dr. McCrae: Yes, the former seems ruled out, but do not be too sure as to pancreatitis. There may have been a slight to moderate grade of acute pancreatitis without any change in the stools. What about the possibility of a perforated gastric ulcer?

Student: The fact that he is taking his food well and without any distress is against this.

Dr. McCrae: What about the possibility of aneurism?

Student: The negative Wassermann reaction is strongly against it.

Dr. McCrae: This is correct, as a positive reaction is present in a large majority of the cases of aneurism. There are several points to be noted. (1) The increase of fever without any increase in pulse rate. (2) The leucocytosis increased somewhat, but not to any marked extent, and is back to the original figure. (3) The persistence of the pain. This is fairly constant and requires occasional doses of morphia, of which gr. ⅙ hypodermically is enough to give him relief for some hours. (4) There has been a definite increase in the jaundice, which, while not extreme, is now distinctly marked. There is no increase in the size of the liver. The tenderness in the region of the gall-bladder is more marked. These seem to point to some condition in the gall-bladder or bile passages as the most probable diagnosis, and yet in some way or other there seems a suggestion of something more. The picture is not exactly the usual one of cholecystitis, but we cannot find positive evidence of anything else.

During the following days there was no marked change in the general condition, except that the fever was lower, but the pain increased and more morphia was required to control it. There was no extreme abdominal distention. The bowels moved well each day without purgative or enema. The pain and tenderness became more localized over the region of the gall-bladder, but both were present in the upper epigastrium. Muscular rigidity has not been marked. The leucocytes remained at about 17,000.

My surgical colleague, Dr. John H. Gibbon, saw the patient frequently in consultation, and on the ninth day from the onset we decided to operate. The patient was anxious to have something done in the effort to gain relief; he did not seem to be gaining, but rather losing, ground, and the signs suggested some inflammatory condition

in the upper abdomen.   The most probable diagnosis was gall-bladder disease, but we felt that this was only tentative and that something else might be found.   We saw the patient together at 1 P.M., March 9th, and went over the abdomen carefully.   There was no distention and the percussion note in the flanks was resonant.   This was noted

Fig. 1.
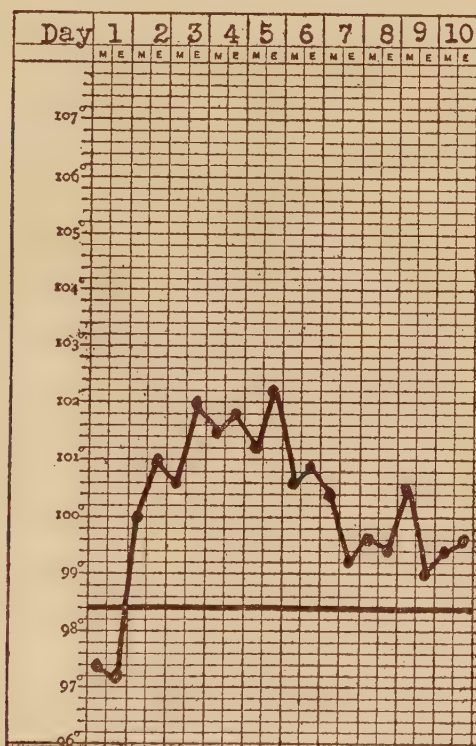
Temperature chart.

with particular care.   The patient was given morphia hypodermically and after this was perfectly comfortable.   At 4 P.M. the anæsthetic was begun (ethyl chloride) and after taking a few breaths the patient died very suddenly.   No change in his general appearance was noted; the pulse at 3 P.M. and at the time of beginning the anæsthetic was 78. Naturally it was thought that the anæsthetic was responsible, but fortunately an autopsy was obtained.

Final Report.—You have seen a number of instances in which the importance of an autopsy was very evident in clearing up misconceptions and in exposing mistakes. There is one point with reference to this case about which I wish to make a confession. My inclination was to blame the ethyl chloride as the cause of death. It has probably been pure chance, but in a certain number of cases that have come under my observation death has resulted from ethyl chloride anæsthesia, and I am always somewhat apprehensive when it is used. In this case I felt that we probably did wrong to give it, but the autopsy proved that the ethyl chloride had nothing whatever to do with the sudden death.

Autopsy.—On opening the peritoneal cavity it was found full of blood and blood clot. The latter weighed 1600 grams, and in addition there was a large amount of free blood present. The liver was not enlarged. The gall-bladder was considerably enlarged and by pressure on it very black viscid bile was forced into the duodenum. It was only after some search that the source of the hemorrhage was found. The lesser omentum was infiltrated with blood, and on dissection it was found that the hepatic artery (Fig. 2) was dilated about its bifurcation, forming an aneurism which measured 2 by 3 cm. It was about the size of medium-sized plum. There was a rupture in its wall and the interior was partly filled by clot, which extended in the branches of the artery into the liver substance. It was evident that here was the source of the blood in the peritoneal cavity. It may be noted that there was no rupture into the stomach, bowel or bile passages.

There were further interesting vascular findings. The thoracic aorta showed a dissecting aneurism between the media and adventitia, which extended for 16 cm. It was not complete and did not involve the whole circumference of the aorta. The inner surface of the aorta showed irregular yellowish nodular areas of degeneration very suggestive of syphilis. In the left internal iliac artery there was a third aneurism measuring 7 cm. in length and 4 cm. in diameter which contained a considerable amount of clot.

Later study of the liver showed that the clot had extended widely through its vessels. The smaller arteries showed an extreme degree of obliterating endarteritis, of the syphilitic origin of which there seems little doubt.

FIG. 2.

The aneurism is situated just above the probe which is passed into the intra-hepatic portion of the artery.

Remarks.—There are several points worthy of consideration as we did not even consider the condition found at autopsy, nor did we diagnose the existence of the aneurisms found elsewhere. Let us discuss them separately.

1. *The Presence of Multiple Aneurisms.*—It is doubtful if recognition of the aortic aneurism was possible. There was very little enlargement of the aorta; a dissecting aneurism of this size is a pathological curiosity rather than a clinical condition possible of diagnosis. We did not make out any increase in aortic dulness during life, but he had a large rounded chest with emphysema which would obscure any enlargement which was not marked. The aneurism of the internal iliac artery was not felt, due perhaps to the thick abdominal walls. No difference was made out in the pulsation in the femoral arteries on the two sides. This was equal in volume and synchronous. Under these conditions it is difficult to recognize an iliac aneurism.

With this goes the recognition of syphilis. When we first saw the patient the possibility of a ruptured aneurism was suggested. The rapid recovery from the shock and the absence of any signs of hemorrhage into any cavity seemed to rule this out. Certainly the negative result of the complement fixation test served to lessen our attention on this point. Should we have been more careful in regard to this? The answer must be in the affirmative. There was a history of all the children of the first marriage having died, two within a short time after birth. This is perhaps no more than suspicious, but the only pregnancy of his second wife resulted in a miscarriage. There was no scar on the penis and no other signs of syphilis. The absence of a positive reaction will help to impress the fact on your minds that a negative Wassermann reaction is not proof of the absence of syphilis. The error in this case will be of some use if you learn that point.

2. *Aneurism of the Hepatic Artery.*—Might we have been suspicious of this if we had been more alert? Undoubtedly, if we had considered the presence of an aneurism, we might have thought of one involving the hepatic artery. But we must recognize that an exact diagnosis would have been difficult. It is interesting to know that the same mistake has been made before, that is, to diagnose the condition as one of disease of the gall-bladder. It is not probable that many of us will have the chance of profiting by the lessons of this case, for few of us will see another instance. But you never know;

some one of you may make a reputation by suggesting its possibility in an obscure case.

3. *Jaundice.*—Why was this present? It may have been due to pressure on the hepatic or common bile duct. At autopsy the gall-bladder was much distended, and it required a good deal of pressure to force the bile into the duodenum. In addition, the bile was very viscid.

4. *Pain.*—What caused the sudden severe pain at the onset? We can only speculate, but very probably a partial rupture occurred then, probably of the intima, with constant tension until the final rupture. This took place a short time before death as three hours before when we examined him there was no evidence of free fluid in the abdomen. This does not exclude the possibility of there being some blood in the peritoneal cavity at that time. It is worthy of note that at the time when the anæsthetic was begun the pulse was only 78, despite the enormous hemorrhage which had occurred. Another explanation is that the pain was due to pressure on the hepatic plexus. When the aneurism is intrahepatic it may be caused by stretching of Glisson's capsule. In many of the reported cases the pain has been paroxysmal. It was not so in this case in which it was constant and without much variation except when controlled by morphia.

5. *Fever.*—There seems no clear explanation as to the cause of this; it has been noted in a number of the reported cases.

Aneurism of the Hepatic Artery.—There are only about 55 cases in the literature, so that you see it is a rare condition. One point in regard to the etiology is of special interest, namely, that syphilis seems to have been proved in a small number of cases, which is in striking contrast to aneurism generally. An acute infection has preceded the aneurism in a surprising number of cases, suggesting an infective embolus, or arteritis, as the important causal factor. Pneumonia has been the most frequent antecedent disease with typhoid fever and osteomyelitis also reported in some cases. In one case jaundice appeared on the twentieth day after the pneumonia and was permanent. In the case reported by Ross and Osler there was pyæmia with multiple abscesses in the liver secondary to pyelitis.

As to position, the aneurism may be extra- or intrahepatic, the majority being extrahepatic. In some cases of multiple aneurisms

both were found. The main trunk has been affected most frequently and next in order the right branch. In the majority of the reported cases the aneurism had ruptured. The largest number ruptured into the peritoneum, but nearly as many ruptured into the bile passages. Rupture has also occurred into the stomach, duodenum and portal vein.

In general, the striking clinical features in the reported cases have been: (1) Pain, (2) jaundice and (3) hemorrhage into the digestive tract, the blood being vomited or passed by the bowel. The pain has usually come on in paroxysms, very suggestive of biliary colic, and in the intervals the patient has been free from pain. A remarkable feature of the hemorrhage is that it has been intermittent. Rupture into the bile passages, stomach or duodenum is evidently present in these cases. The explanation of the occurrence of jaundice as due to the presence of blood in the bile ducts can explain only some of the cases, and it does not apply in the present case. Fever has been noted in a considerable number of the reported cases. In a few cases there was pulsation of the liver or a definite tumor. In one instance of tumor the diagnosis was not made at operation but only at autopsy. In the cases which came to operation the diagnosis was not made even after opening the abdomen in about half of those reported. In the great majority of cases the diagnosis of ulcer or gall bladder disease has been made.

As to treatment it is evident that ligation is indicated when operation is possible, but there is always the danger of hepatic necrosis. There have been two successful cases of recovery after operation (Kehr, Anderson). In Anderson's case the patient was operated on after rupture of an aneurism of a branch of the artery. Curiously enough he had two other aneurisms, one of the radial previously and one of the tibial artery after the operation. He improved rapidly under specific treatment. If, as is suggested, a large proportion of the aneurisms of the hepatic artery are not due to syphilis, we have less to hope for by specific therapy.

CLINICS FOR PHYSICIANS IN PULMONARY TUBERCULOSIS

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THE war has taught us medical men many things. In the first place, it has taught us that we did not know as much as we thought we did. Again, it has taught us the value of team-work, both for the better diagnosis and treatment of our patients and for the enlargement of our own knowledge through group study of cases. It has taught us also the value of standardizing our methods of diagnosis and treatment, so that our results could more readily and accurately be compared. Again, it has shown us how much can be accomplished in any special domain of medicine by short intensive courses, and such courses, as we know, covered all the various specialties in medicine and surgery, orthopædics, laryngology, tuberculosis, X-ray, laboratory methods, etc., etc.

In tuberculosis there was lack in the medical department of the army, of trained phthisiotherapeutists. Under the able direction of Colonel Bushnell and his assistants, intensive courses in the subject were instituted at various hospitals and thus the requisite number of men were found to do the enormous work of examining all the men of our great army for tuberculosis.

I do not mean that a few months' training can turn out an accomplished tuberculosis expert any more than an expert in any other department of medicine, but it can teach the general medical man a good deal more than he knew before with regard to tuberculosis and enable him to do creditable work when directed and guided by more seasoned experts. Why cannot this army plan of a short period of intensive work be instituted in civil practice with reference to tuberculosis, especially in its early diagnosis?

For many years now the general practitioner has been blamed, and often unjustly, for his inability or neglect in making an early diagnosis of pulmonary tuberculosis, although he is the man who first sees most cases of tuberculosis in his community. If we could

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by such a plan stimulate the interest of the general practitioner, enlarge his knowledge and increase his skill in the diagnosis of tuberculosis, it would lead to the earlier detection of the disease and to the saving of many lives, both by prevention and timely treatment.

Quite every state has one or more public sanatoria; some have several. In none of the state sanatoria, so far as I am aware, is the abundant material used to any extent for teaching purposes, although I, myself, in one instance, have made use of a sanatorium in the vicinity of Boston for the instruction of medical students. Almost invariably the sanatorium is too far away from the large cities, where the medical schools are situated, to be available for medical students, but what I propose, however, is an arrangement for intensive courses for physicians, somewhat after the plan pursued by the medical department of the army, as previously mentioned. For example, a section composed of, say, a dozen or twenty physicians from various parts of the state could be invited to come to the sanatorium for such an intensive course of study. They could be given accommodations and board without cost to themselves, and afforded an opportunity for clinical work in the diagnosis and treatment of tuberculosis, such an intensive course lasting perhaps two weeks or more.

These courses could be frequently repeated, so that in the course of the year a very considerable number of physicians in the state would be enabled to avail themselves of this privilege.

In addition to the regular staff of the sanatorium some recognized expert could be employed who would be willing, I am sure, to do this for the public good, or he might be paid a reasonable honorarium. Moreover, the temporary attachment to the institution of such an expert would not only render such intensive courses attractive but would at the same time stimulate the staff of the sanatorium and redound to the general improvement of the medical service.

The expense of providing for the accommodations of such classes could well be borne by the state, for the advantage of having better trained physicians in the diagnosis of tuberculosis, and consequently would more than repay the cost. In the summer time tents for accommodation could be used. Sometimes, as occurred last winter in some of our Massachusetts sanatoria, there are vacancies, or even empty wards, which could be temporarily employed for this purpose. Most

physicians take a vacation, and they might, and I believe would, be glad to spend a couple of weeks of their vacation in this useful way, which would have many attractions for them.

This very plan has been tried, I believe, in one of the Canadian sanatoria. Once such a course has been tried, I believe it would become popular with physicians, and one might wonder why it had not been inaugurated before.

Another means of aiding and teaching the general practitioner as well as the public is by means of the itinerant expert so called, a plan which has been tried in various states, primarily as part of the general tuberculosis campaign, but it is obvious that it is a very useful, educative measure for the local physicians. For example, the Massachusetts Anti-Tuberculosis League is at present conducting such an itinerant expert service in Barnstable County, Mass. The expert goes from town to town, meets the local physicians, and aids them in making a diagnosis in doubtful cases, or holds clinics. Thus the physician and his patients not only obtain expert advice, but the former, the physician, learns from the expert and increases his knowledge and skill in detecting the disease.

In the Barnstable County experiment just mentioned the League bears the expense of the undertaking. The expert acts as a consultant only, and only when asked, and consequently there is no fear that the physician will lose his patient. So far the plan has worked admirably.

In the well-known Framingham health and tuberculosis demonstration such a tuberculosis expert is constantly employed, who works in perfect harmony with the local practitioners, and it is evident that such service must constitute an exceedingly valuable educative influence in the early diagnosis of tuberculosis. Doctor Armstrong, the executive officer of the Framingham demonstration, has declared that the employment of the tuberculosis expert is the most important and valuable measure in the whole experiment.

Large numbers of the medical profession are now returning from their war service with increased and broader knowledge and greater enthusiasm for their work. It would seem to be an opportune time to take advantage of this new awakening, in some such way as I have mentioned, for the intensive study of tuberculosis, particularly in acquiring greater skill in its early diagnosis, which is one of the most fundamental conditions for the ultimate control of the disease.

HEMORRHAGE FROM THE URINARY TRACT

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THIS subject is one which often confronts both the internist and surgeon, as well as the specialist in the other branches of medicine; and one which until relatively recently has often been obscure, if not entirely unexplained. But now with the more refined methods of diagnosis we can in almost all cases determine with certainty the etiology and source of blood from the urinary tract, and the task is a decidedly thankful one.

In a given case of hæmaturia there are three all-important questions to be answered:

1. Is there actually hæmaturia?
2. Where is its source?
3. What pathology occasions it at the source?

The first question naturally maintains only for very small amounts of blood, as any marked quantity is readily determined by gross examination. Small amounts are readily determined by (a) microscopic examination, (b) chemical tests, the simplest of which may easily be carried out at the bedside.

A few drops of KOH is added to the suspected urine, and boiled, the phosphates are precipitated, which, unless blood is present, are whitish or gray, but with an admixture of blood appear brown or reddish. Microscopic control is not necessary but, I believe, advisable. Even the smallest amount is pathological and an attempt at least should be made to explain its presence. Generally speaking, on gross examination we are liable to overestimate the quantity of blood present in a given specimen. Only when coagulation occurs does the amount of blood exceed that of the urine.

In answer to the second question—Where is the source of blood?—there are at least six or seven possibilities. From above downward we must consider:

1. The renal parenchyma.
2. The renal pelvis.

3. The ureter.

4. The bladder.

5. The seminal vesicles and vasa deferentia.

6. The prostate gland.

7. The urethra posterior and anterior.

These various locations of hemorrhage can usually nowadays be determined with accuracy by the use of the newer methods of examination, especially cystoscopy, ureteral catheterization, pyelography, röntgenography and the various functional tests, which, for the sake of brevity, will be discussed in the treatment of the third question: What pathology determined the hemorrhage at its source?

Starting again from above downward in regard to the differential diagnosis of renal lesions causing hæmaturia, experience is necessary and even the most experienced surgeons, using the most modern and approved diagnostic methods, are occasionally forced to an exploratory incision before they render a correct diagnosis. This procedure must not be lightly passed over, nor does recourse to it stamp the surgeon an incompetent diagnostician, nor does it diminish the great value of our newer course.

Renal Hemorrhage.—Renal hemorrhage is usually due to one of the following causes: tumors, calculus, injury, congestion and acute inflammation.

The first-mentioned is often the most difficult to diagnose and patients frequently go for long periods with hypernephroma, for example, when its presence is not at all suspected, because in certain cases the hemorrhage therefrom does not begin until very late in the course, in fact, long after metastases are present. Bleeding is often the only symptom in these cases. Pain, loss of weight and enlargement on palpation may fail entirely. The bleeding is similar to that of bladder tumor and is usually characterized by suddenness and apparent absence of cause or precipitating moment; it is usually profuse and of relatively long duration and is not controlled by therapeutic measures, in contradistinction to that occasioned by calculus, as we shall soon see. If the other above-mentioned symptoms, especially enlargement of the kidney on palpation, are present, then the diagnosis is more readily made.

A differential diagnosis between the various types of renal tumor

is almost impossible, excepting by exploratory incision, and, in fact, is of little practical value.

Renal functional tests, such as the phenol-sulphonephthalein, phloridzin, or indigo-carmine, in these cases avail but little, because a marked difference is not detected, except when much renal parenchyma is destroyed. They should, however, not be neglected. The X-ray in certain cases may be of marked value, showing enlargement which is not palpable. Ureteral catheterization is the method, of course, by which the source is accurately determined. The presence of hæmaturia of the type described and positively traceable to the kidney is an indication for an exploratory incision, in my opinion.

In tuberculosis of the kidney we frequently observe general symptoms of tuberculosis, and suggestive history thereof, either in the patient or members of his family. Furthermore, pyuria is usually present and the urine shows an acid reaction. Microscopical examination of the centrifuged urine for bacilli of tuberculosis and, finally, animal inoculation indicate the causative agent. Of the more modern laboratory procedures may be mentioned the antiformin method of digesting extraneous material in the urinary sediment and the Bloch technic, in which an inguinal gland is traumatized by squeezing it between the fingers, thus producing a *locus resistencia minoris,* in which the tubercle bacilli injected in the immediate neighborhood may quickly produce their characteristic histopathology. A combination of these procedures has been advocated by Neckar and Bachrach, of the Rothschild Hospital, Vienna. We must again rely upon the ureteral catheter and the X-ray for the localization of the process. Functional tests may be of decided value, especially in obscure cases in which the products of inflammation do not discharge freely into the renal pelvis. Bleeding in tuberculosis of the kidneys is chiefly early in the course and gradually diminishes. Many cases begin with marked hæmaturia. Enlargement of the kidney in certain cases can be made out by palpation.

Calculus.—The bleeding from renal stone may be considered as almost typical, associated, as it frequently is, with characteristic colic. The characteristics of the colic are too well-known to require any elucidation. Here again of prime value in the majority of cases is the X-ray. Practically all stones show shadows except the urates.

The kidney is usually tender on pressure. Stone is most likely to be confused with tuberculosis of the kidney.

Hæmaturia resulting from injury to the kidney usually is not difficult of diagnosis. Such injuries frequently are crushing in nature, as between cars, or when heavy vehicles pass over the body. Other injuries frequently are associated. Gunshot wounds may also be causal.

Acute Nephritis.—Acute nephritis occasioning hæmaturia is of the so-called glomerular type and may be difficult to differentiate from the hæmaturia of tumor. Later in the condition, however, casts and albumin are found in appreciable quantity after the hæmaturia has ceased. This type may be very hard to diagnose, because, in spite of the condition being bilateral, the blood may proceed from one side only. The functional test may also be of little value, showing only that the process has caused greater pathology on one side than the other. There are no palpatory findings nor usually are there subjective symptoms referable to the condition. The onset is usually precipitate and unassociated with pain.

Congestion of the Kidney.—Blood is almost always absent in simple congestion, according to von Leube, except for isolated red blood corpuscles in the sediment, while if it can be demonstrated in an undoubtedly existing engorgement, it almost invariably points to the simultaneous development of nephritis or hemorrhagic infarct. The quantity of urine in cases of congested kidney is small—1000 c.c. and less, dark red in color and of high specific gravity. Casts, if found, are of the simple hyaline variety. With improvement of the underlying cardiac condition the urine clears up in the course of a few days.

Another type of hæmaturia of renal origin frequently reported, which I personally cannot admit, is the so-called hemorrhage from the healthy kidney spoken of by many authors. This is probably a fantasy, and I think, furthermore, that many, if not all, cases will be found to be of tuberculous origin, if properly examined.

In wandering kidney we frequently see some hæmaturia from kinking of the pedicle, causing a passive congestion of high grade. This is usually transitory, and may often be determined either by palpation or X-ray.

Those lesions of the renal pelvis causing bleeding, chiefly of

academic interest and usually associated with the same lesions of the
kidney, namely, stone, tuberculosis and tumor, may be quite rapidly
dismissed.   The microscope, as well as the cystoscope and uretral
catheter, usually fail in differentiating pelvic lesion from those of
the parenchyma.   Cases, of course, speak for disease of the renal
substance.   The presence of uretral epithelium in sedimented or
centrifuged specimens is likewise of little value, as it may be present
in hemorrhage from both sources.

Ureter.—The same maintains concerning ureteral lesions which
are associated either with those of the bladder or of the kidney,
namely, stone, tumor and tuberculosis.   The diagnosis of stone in
the ureter is very important from an operative and technical stand-
point, and the use of a ureteral catheter of sufficient density to show
plainly on the Röntgen plate is of great value in determining whether
or not the stone lies within the ureteral lumen.   Recently I have used
a 7 per cent. or 8 per cent. solution of collargol, which injected into
the ureter gives a distinct shadow though of not too great density.
When the shadow produced by the suspected stone merges with that
of the collargol solution in the ureter, it may be said that it is in all
probability that the shadow lies within the ureter and is not that
produced by a phlebolith nor a calcified gland.   The accuracy of this
procedure may be still further assured if stereoscopic pictures are
made.   Hemorrhage from the ureter is usually scant in amount and is
associated with colicky pains, usually of marked severity.   The use of
a catheter tipped with wax, which may become scratched upon coming
in contact with the stone in the ureter, is another method of deter-
mining the presence of a concretion within the lumen.

Those lesions of the bladder which cause hæmaturia may usually
be diagnosed correctly if there is no obstruction to the passage of the
cystoscope.   They are chiefly tumor, stone, foreign bodies and cystitis,
with or without ulceration.

Hemorrhage from tumors of the bladder is similar to that of
tumors of the kidney and is characterized by its sudden onset, long
duration, its failure to respond to therapeutic measures and its great
amount.   It may persist for weeks or even months.   Bleeding and its
subsequent anæmia are usually the chief symptoms.   That produced
by stone is of shorter duration, of lesser amount and is referable to
exercise and change of position and associated with pain or strangury.

The use of the stone searcher or cystoscope will usually differentiate these causes readily. The diagnosis of foreign bodies in the bladder is determined by history and cystoscopic examination.

Hæmaturia due to cystitis is associated with tenesmus, frequency and the microscopic findings of pus and microörganisms, as well as red blood corpuscles. Especially in tuberculous cystitis is the hemorrhage small in amount, even in the presence of ulcerations. In these instances again the cystoscopic examination is of great value in diagnosis, showing hyperæmic areas, suggillations and ulcerations.

I cystoscoped a patient about a year ago, in whom I could find no other cause for severe hæmaturia of bladder origin than that due to marked *arteriosclerosis of the bladder wall.* At my request a fundus examination was made and here, also, arteriosclerotic changes noted. I find no report of a similar case in the literature. The patient, placed on appropriate treatment, was free from hæmaturia when I heard from him last, about four months ago. Hemorrhage from the seminal vesicles is associated with bloody pollutions and terminal hæmaturia. The objective findings are determined by rectal examination, such as swellings, nodules and areas of marked tenderness. This type is to be differentiated chiefly from the two other sources below the bladder causing terminal hæmaturia, *viz.,* cystitis colli or inflammation of the neck of the bladder and tumor of the posterior urethra, usually papilloma. The presence of such tumor may be readily seen by either the posterior urethroscope of Goldschmidt or of Wossidlo, and, in fact, can usually be seen with the ordinary straight tube. This lesion produces usually no subjective symptoms.

Hemorrhage from the Posterior and Anterior Urethra and Prostate.—Hemorrhage may arise from the anterior urethra, posterior urethra, or prostate. As far as these sources of hemorrhage are concerned, we must remember the physiological division of urethra into anterior and posterior, and that the sphincter externus divides them so that hemorrhage from the anterior urethra shows at the meatus, while that from the urethra posterior passes over the internal sphincter into the bladder. When hemorrhage from urethra posterior is marked, it may be very difficult to differentiate it from hemorrhage of bladder origin. If, as usual, the hemorrhage is slight, then the first glass is clear and the second cloudy or sanguinolent or, just at the last moment, a few drops of pure blood are emptied.

Terminal bleeding indicates that the source of the hemorrhage is just in front of the bladder neck. There are, however, two exceptions to this rule: first, small bladder stones which, at the end of the act of urination, impinge against the sphincter and by the trauma inflicted cause hemorrhage. The same may occur when prostatic stones intrude into the urethra, as also with small papillary tumors of the bladder located in the immediate vicinity of the sphincter. In these cases the easily-bleeding papillæ may be compressed by the sphincter internus and a small vessel may burst, giving rise to terminal hæmaturia.

The anterior urethra is an unusual site for hemorrhage. In this location bleeding is usually due to urethritis, especially gonorrhœa, or the injections or irrigations used in treatment of the condition. Diagnosis is usually very easy from the history and microscopic examinations.

Strictures of the urethra seldom occasion spontaneous hemorrhage. Not infrequently proximal to structures of the urethra are dilatations, in the walls of which are distended vessels which may rupture and cause hemorrhage. Diagnosis is not difficult and is effected by the insertion of an olive-tipped bougie, which demonstrates the presence of a constriction in the course of the canal.

Injuries of the urethra from falls, blows, kicks, and instrumentation may, of course, cause hemorrhage, but the history alone usually makes the diagnosis. However, when a history is not obtainable, and there is no evidence of trauma to the skin, the diagnosis may not be so simple. But the introduction of a soft Nelaton catheter will usually clear up the case. If there is but a small lesion of the urethra, the tip will readily glide over it, but if the break in continuity is great, the catheter tip engages therein and thus leads one to its location and character.

For lesions of higher origin the cystoscope is fortunately of great aid in diagnosis. By its use one can determine whether the blood is coming from the entrance to the bladder or from the prostate, or whether from the right or left ureteral orifice. When the bleeding is so small as to give only a slight discoloration, then the cystoscopic examination alone will often not suffice to make the diagnosis. Here we must resort to catheterization of the ureters and examine the urine microscopically and chemically for blood from each side. It

is, of course, possible to produce trauma of sufficient grade by the procedure of catheterization through a rather narrow ureter. This occasion is best determined by microscopic examination, the red blood corpuscles from recent catheter trauma show the usual concavity or disk shape of the corpuscle and the spike-like projection familiar to you, while in spontaneous hemorrhage there are noted especially faded-out, indefinite corpuscles and many so-called " shadows." Also when the catheter is advanced a little further into the ureter, the bleeding ceases or at least diminishes, while in spontaneous hemorrhage it remains the same. Furthermore, we know that when the ureteral catheter is left *in situ* a sufficient length of time, occasional red blood corpuscles are noted as a result of diapedesis; for that reason, the specimen examined for blood should be gained in the first few minutes after introduction of the catheter.

Lesions of the prostate and prostatic urethra are less well known and less sharply defined. These hemorrhages occur with prostatic hypertrophy and are of sudden onset and are often very profuse. They are usually not associated with pain but with urinary obstruction or retention. A diagnosis is made by rectal and, if possible, by cystoscopic or urethroscopic examination.

In conclusion, I may state that while the diagnosis of hemorrahge from the urinary tract is not in every case possible, as far as its sources and pathology, that modern methods combined with careful, painstaking examination into symptoms, both objective and subjective, combined with the free use of microscopic, chemical and bacteriologic examination of the urine will lead in the vast majority of cases to a correct understanding of the cause, which, after all, is of major importance to the welfare of the patient, because then, and then only, can rational, intelligent therapy be begun.

GONORRHŒAL SALPINGITIS

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WE have to-day for operation a Russian woman, aged thirty, with the following history. Her chief complaint is pain in the abdomen, colicky in nature, with burning on urinating and a yellow vaginal discharge.

Onset and Course.—Patient has been married six years and has no children. One year ago, she had a miscarriage at three months, and states she was very ill with a fever. She thinks she had a second miscarriage three weeks ago when she was two weeks past her menstrual period. She says she was very ill at this time and also had a high fever. Since the last miscarriage, she has had pain in the lower abdomen. A whitish-yellow vaginal discharge has been present for several months. She also complains of burning on urination which has been present for several months.

Family History.—Negative.

Past History.—Negative except as described.

Physical Examination.—Head, neck, chest: Negative. Heart: Systolic murmur at apex, transmitted to axilla. Abdomen: Pain in right and lower left quadrants, more on the left side.

Pelvic Examination.—Vaginal: Introitus admits two fingers snugly; slight discharge is present. Cervix is normal in size, slightly softer than normal. Corpus is normal in size, and slightly retroverted. Left tube and ovary palpable and painful, thickening in right ovarian region.

Blood Count.—Reds and whites: Normal.

Urinalysis.—Negative.

Diagnosis.—Chronic bilateral salpingitis; retroversion; probable extra-uterine pregnancy; mitral regurgitation.

We shall make a midline incision ample in length to facilitate the intra-abdominal work. We aim to make our incision exactly in the midline, by so doing we eliminate the chance of striking any

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bleeders. Also, we make the lower end of the incision close to the pubic bone as an inch here is worth two inches higher up, inasmuch as our pathology lies low down in the abdominal cavity. We next open the peritoneal cavity and insert a Balfour self-retaining retractor. The patient is placed in the Trendelenburg position; we pack a large laparotomy sponge against the bowels; this sponge is about thirty inches square and is sufficient to keep the intestines where they belong. We find this one large sponge an advantage, inasmuch as small pads have a tendency to work in between the coils of intestines and before we know it we have the sponges around the upper abdominal cavity rather than acting as a barrier between the bowel and the field of operation. Another advantage is that we have little difficulty in keeping track of one large sponge. Occasionally it is necessary to use one or two small ones in addition, especially where the abdominal cavity is large or where the patient has a tendency to strain.

You can now see that we have ample room and that the only portion of bowel visable is the sigmoid; furthermore, there will be no chance to traumatize the bowel by manipulation, as is so apt to happen when a knuckle of bowel pushes down into the field. Pushing back the bowel or handling the same in any way adds to the shock, which we wish to avoid.

Upon inspection we find blood clots in the pelvis suggesting a ruptured ectopic pregnancy. The right tube is hyperæmic, enlarged and adherent; the left tube is greatly enlarged, is deep red in color and has many blood clots adherent to it. The right ovary has undergone cystic degeneration. Our diagnosis is ectopic pregnancy of the left tube, chronic gonorrhœal bilateral salpingitis with cystic degeneration of the right ovary.

One of the most frequent causes of ectopic pregnancy is gonorrhœal infection of the tubes. Apparently this condition preceded the ectopic pregnancy. Gonorrhœa causes a destruction of the lining epithelium of the tubes, creating a condition producing sterility, and sterility is one of the important factors in the etiology of extrauterine pregnancy. As we just stated, by impairing the normal function of the epithelial structure of the tube, we have a condition which prevents the ovum after impregnation with a spermatozoon from reaching the uterus. Under normal conditions the fertilized egg continues its course until it reaches the uterine cavity, where it

embeds itself in the endometrium and there develops. Implantation in the tube is due to its inability to reach the uterus. There are several causes for this condition to occur, either a perisalpingitis or a salpingitis. By destroying the ciliated epithelium we destroy the power of the lining membrane to carry the ovum downward. Also, the ovum may find its way into a pocket or diverticulum of the tube, or it may lodge in an accessory tube, which latter condition is rare. Pressure from without, such as tumor masses or adhesions, may occlude the tubal canal. This case is no doubt caused from the inside inflammatory conditions which previously existed with the gonorrhœal infection.

When a fertilized ovum becomes implanted in the tube it begins to dig its own grave; usually within the first three months of pregnancy. However, cases have been known to go to full term.

The tubal tissue is capable of only a mild decidual reaction, so that the fœtal tissue is poorly nourished. The softening of the pelvic organs due to pregnancy softens the tubal wall, which becomes thinner as the ovum grows larger and rupture is apt to ensue. The mother is then in great danger. On the other hand, tubal abortion may take place. This case appears to be one of that class. Rupture of the fœtal capsule takes place in tubal abortion and the embryo and the fœtal tissues are rapidly absorbed. A hæmatocele forms at the dependent parts, usually in the cul-de-sac of Douglas, if adhesions have not obliterated this space; if so, in front of the uterus or wherever it can find lodgement. The hæmatocele in this case is in the cul-de-sac.

It has been formed by trickling from the end of the tube and bleeding fortunately ceased before a large hæmatocele was formed. The patient could have bled to death in this manner.

Sometimes the hæmatocele is diagnosed as a pelvic abscess and drained, infection following, and sometimes death of the patient. A hæmatoma could have been formed from the inflammatory action alone, but not likely to such an extent. We will have sections made of this tube. (Sections show chorionic villi.) Usually with an extra-uterine pregnancy we have periodic bleeding from the vagina. In this case we did not, or at least, we did not elicit the symptoms in taking the history. Bleeding of this nature is due to blood trickling through the uterine cavity from the site of the extra-uterine pregnancy. According to Sampson, this bleeding is due to venous

congestion of the uterus, due to changes it undergoes not unlike a normal pregnancy, rather than the preceding cause. Often a decidual cast of the uterine canal comes away and usually shreds of decidual tissue.

The question arises—Shall we remove both tubes? Due to the fact that she has had a previous gonorrhœal salpingitis we shall, because gonorrhœal infections are practically always bilateral. In this case the other tube proved by its appearance that it had been infected and had not recovered. Figures show that only 33 per cent. have normal pregnancies afterward and that 15 per cent. have a repeated ectopic pregnancy.

The question arises—Shall we perform a hysterectomy? In view of the fact that the left ovary is normal and the patient only thirty years of age, we shall not. We shall remove, however, the fundus of the uterus, including the parsinterstitialis with both tubes and thereby remove all of the pathology. Gonorrhœal infections involve the cervix, the fundal portion of the uterus and the tube. Many investigators have shown that the corpus escapes the destructive action of the organism, but that the parsinterstitialis does not. By preserving the corpus and the normal ovary, we shall have a patient who will menstruate and at the same time benefit from the internal secretions of the ovary, which is highly desirable in a patient of this age. The questions of menstruation is more or less a psychological matter, no doubt; but still we feel that it is worth while. Also, it seems to me that we can preserve the blood-supply to the ovary better by doing the high amputation operation rather than by doing a hysterectomy.

What will be the fate of this ovary? Very possibly it will undergo a cystic degeneration due to altered circulatory changes. It will then become painful and very likely have to be removed. A considerable number of cases, where an ovary has been left and its circulation interfered with, either by operative procedures or preëxisting inflammation, degenerate, and it has to be removed at a later time.

This is one of the problems which we have to contend with in gynæcology. In young women where one ovary is healthy at time of operation we save it, even though a considerable number later become diseased. However, where the organ is at all diseased we make a clean sweep of all pathology, irrespective of the age of the patient, rather

than have them return to have the pathology removed at a second operation.

It is well never to operate on a gonorrhœal salpingitis until the patient has been given every possible means for recovery by conservative treatment. Many patients make a recovery from this condition and bear children, while others are clinically cured, even though we may find thickened tubes, which have caused the patient to remain sterile.

Out of a thousand cases of pelvic infection operated upon at Cook County Hospital, one hundred and thirty-eight, or $13\,{}^8/_{16}$ per cent. had been previously operated upon. Most of these cases were operated upon a second, a third, or a fourth time because pathology existing at the time of the first operation was not removed. Wrong diagnosis was responsible for part of this. For instance, cases of salpingitis had had an appendectomy performed. By going into the history carefully with the patient at the time of the second operation, we were convinced that salpingitis existed previous to the first operation. Most of the cases, however, had one tube or a portion thereof removed when the disease was present in both tubes, also because the patients were young, a diseased ovary was left which was the cause of the second operation.

Do not operate unless it is absolutely necessary; but if it is necessary, remove all of the existing pathology. However, if we are in doubt about the condition of an ovary in a young patient we advise saving it, even though a second operation may be necessary. We have now done what we call a Bell-Beutner operation. We have removed both tubes and the fundus of the uterus as well as the right ovary. We have conserved the left ovary and, we hope, its blood-supply as well. We have used the bladder peritoneum to cover over the raw surface created by the preceding menœuvre; this point in the technic is known as the Rossini technic. It gives us plenty of peritoneum to cover over the raw surfaces as well as to support the bladder, and while it appears as though we might have bladder symptoms following this step, as a matter of fact, we do not. The incision is closed in the usual manner.

A CASE OF CANCER OF SIGMOID WITH ACUTE ILEUS TREATED BY CÆCOSTOMY FOLLOWED BY MIKULICZ TWO-STAGE RESECTION USING LOCAL ANÆSTHESIA

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ACUTE intestinal obstruction in a patient past three score and ten, afflicted with impassable cancerous stricture of the large bowel, is not a pleasant thing to contemplate, much less deal with. Even in a younger person suffering from cancer of the large bowel but free from acute obstruction the operative margin of safety is none too great. Successfully to deal with the former proposition requires marshalling of all known methods of increasing the margin of safety to the greatest extent possible. It was with this problem in mind that we proceeded surgically with the following case:

C. B., female, white, aged seventy-two years, widow, referred by Dr. Herman E. Albrecht, was admitted to Polyclinic Hospital on May 5, 1920, at 8:45 P.M. When seen in consultation at her home one hour before admission, the patient was distressed by inability to retain food without vomiting and by inability to achieve a bowel movement. This state of affairs had been going on for several days, while for four months the patient had been having constipation, alternating with diarrhœa. Before that the bowels had always been regular—in fact, the patient had always enjoyed good health, except in July, 1919, when for the first time she complained of cramps in left side and front of abdomen—cramps which she compared with a labor pain. Of late she has been losing flesh. The family history revealed no instance of malignancy or tuberculosis.

Physical examination revealed a fairly well-preserved old lady lying uncomplainingly and quietly in bed, though somewhat distressed, especially when vomiting occurred. The vomitus was watery and bile-stained in character; there was no evidence of regurgitation of the contents of the gut distal to the bile papilla. There had been no bowel movement for several days. The abdomen showed a moder-

ately well-developed panniculus—about two inches of subcutaneous fat. The abdomen was uniformly and symmetrically distended, and the writhings of hyperperistalsis were evident. The stethoscope revealed very audible gurgling in the vicinity of the splenic flexure of the colon. The area of liver dulness was diminished. Owing to the great distention, no tumor could be palpated. Vaginal and rectal examination revealed no pathology. The tongue was coated with buff. The thermometer registered 100° F., and the pulse was 90. The heart, lungs and nervous system were negative.

Diagnosis.—The working diagnosis was acute intestinal obstruction, while the pathologic diagnosis was malignant stricture of the large bowel which had recently become impassable. Immediate enterostomy under local anæsthesia was advised, whereupon the patient was removed to hospital and prepared for operation.

Operation No. 1 (May 5, 1920, 9 P.M.).—A preliminary of morphine sulphate ¼ grain was given by hypo. Using procaine ½ per cent. solution and working through a long McBurney incision the cæcum was drawn through the wound and found greatly and tensely distended with gas. A silk purse-string suture circumscribed the site of intended puncture through the anterior longitudinal band, the puncture was made, and before leakage could occur a No. 14 F. soft rubber catheter was introduced three inches into the cavity of the cæcum, which immediately collapsed from the escape of gas followed by soft fæcal material of pea-soup consistency. The purse-string was puckered up and tied, and the cæcum was secured on the surface of the abdomen by a heavy through-and-through white silk ligature, which passed through all layers of one side, beneath the cæcum in the depths of the incision, and out through all layers of the opposite side, each end being tied over a short length of rubber tubing resting on the skin; when this suture was tightened it apposed the margins of the incision opposite the centre so that the cæcum rested upon the skin surface. The angles of the incision were closed. The free end of the tube was placed in a bottle, and the cæcum and wound were covered with a boric-acid ointment dressing.

This operation safeguarded the patient against the toxic effects of acute intestinal obstruction, which toxic effects had not had time to develop previous to operation. By it she was relieved of the prodromes of nausea, vomiting, and the discomfort produced by the con-

fined gas and fæcal material. The tube drained freely and loosened and slipped out of the cæcum at the end of four days. By this time the discharge from the fistula had changed in character from fluid fæcal matter to that normal for the cæcal portion of the gut—chyle—an odorless, watery substance suspending undigested food particles; this fluid was ejected with each peristaltic wave. It irritated the skin to a very slight extent only.

A skiagram taken after a draught and clyster of barium located the obstruction in the descending colon; this skiagram was not entirely satisfactory, however, and the barium so upset the patient that it was deemed inadvisable to repeat the dose. Accordingly, an exploratory operation was undertaken; first, definitely to locate the obstruction; secondly, to determine its character and extent, and thirdly, to learn whether or not metastases had taken place. The type of curative operation would be based not upon these findings alone, but also upon the extent of fæcal loading of the colon and the amount of subserosa fat, for with great septic content of the bowel and thick padding of subserosa fat, one-stage resection with immediate anastomosis of the cut bowel ends would be extremely hazardous, indeed, if not fatal from leakage peritonitis.

Operation No. 2 (May 13, 1920).—A preliminary of morphin sulphate ¼ grain was given by hypo. Using procaine ½ per cent. solution and working through a transverse left upper abdominal incision the liver and mesenteric lymph-nodes were explored for metastases, and the colon was palpated from the hepatic flexure distally toward the anus; just above the rectosigmoid junction an annular scirrhus was encountered (see Fig. 6, frontispiece). Above the stricture fæcal impaction was marked, and the subserorsa fat was well developed. The object of the exploratory operation having been accomplished, the wound was closed without drainage. The patient was in excellent condition, but the tumor could not be dealt with through the incision that had been employed, and it was not considered wise to make another incision and proceed further at the present sitting.

This second operation produced no ill-effects, and the wound healed by first intention and as perfectly and soundly as transverse wounds always heal in the absence of infection. The exploratory was fruitful in determining the type of curative operation. The

fæcal impaction that had doubtless been accumulating for several weeks previous to the time the stricture became impassable represented a large amount of highly-septic material, which would attack the suture line of the technically most perfect anastomosis following resection. And the large deposit of subserosa fat would interfere with peritoneal union—so essential in bowel healing—and provide pabulum for the seething bacterial content of the fæcal impaction mass. Not even the tube method was considered feasible. The one operation to which these contraindications to primary resection did

Fig. 1.
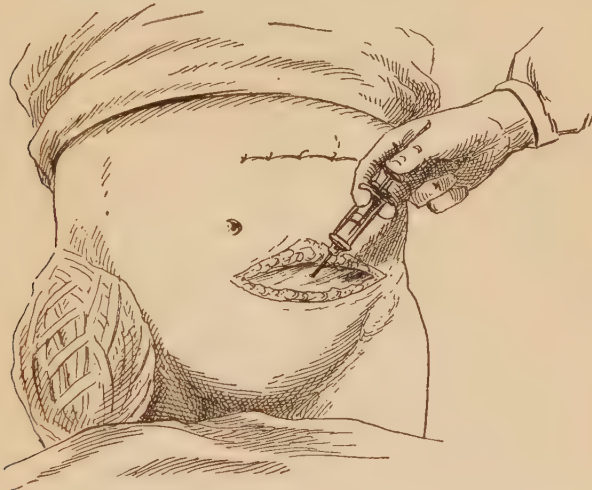
In the left lower quadrant is seen the transverse incision being made under local anæsthesia for the first stage of the Mikulicz partial colectomy. Above is the exploratory transverse incision, now healed. On the right side is the protective dressing over the cæcostomy area.

not apply is that described by Mikulicz (" Chirurgische Erfahrungen ueber das Darmcarcinom," *Archiv. f. klin. Chirurgie,* Bd. lxix, 1903, pp. 28–47), which is a two-stage operation. Additional safety was sought in the choice of local instead of general anæsthesia, for the latter, when used in the aged, is liable to give rise to post-operative hypostatic pneumonia.

Operation No. 3 (May 20, 1920).—Mikulicz first stage. A preliminary of morphin sulphate ¼ grain was given by hypo. Using ½ per cent. solution of procaine and working through a transverse incision opposite the spina iliaca anterior superior (Fig. 1) the loop of

lower sigmoid bearing the cancer mass was mobilized by dividing the outer leaflet of mesosigmoid until the loop could be freely brought out on the surface of the abdomen (Fig. 3). That peritoneal surface of each barrel of the loop which lay between the mesenteric attachment and the outer tenia coli was contacted with its fellow by two lines of interrupted sero-muscular silk sutures of a Lembert type—one line at each boundary of the surface—for a distance of three and one-half

FIG. 2.
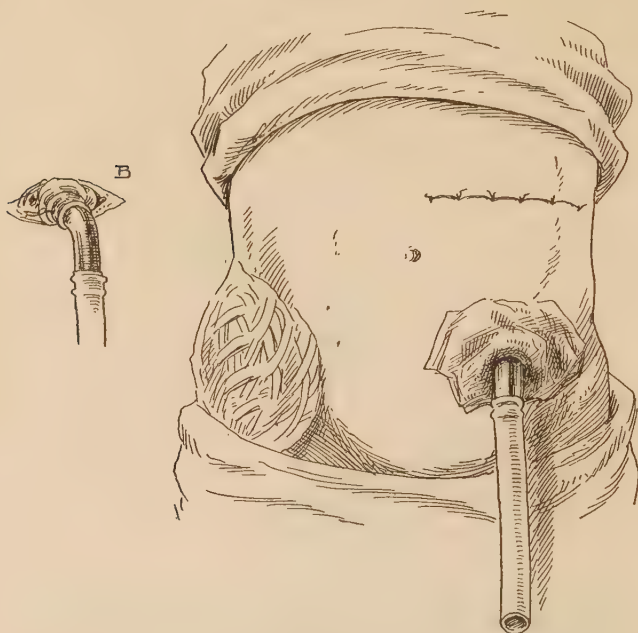
After extirpation of the cancer-bearing knuckle of gut a Paul glass tube was inserted into the proximal orifice and secured by a silk purse-string, as shown in B.

inches downward from the apex of the loop, thus establishing a spur between the barrels of the loop. The base of the loop was sutured to the parietal peritoneum, using interrupted catgut sutures, and the loop was further sutured to the skin edges, using the same material. The wound was now closed up to the emergence of the loop. A dressing of ointment gauze was placed on the skin around the loop, while the remainder of the loop was covered with dry gauze. At the end of the operation the patient's condition was excellent.

FIG. 3.
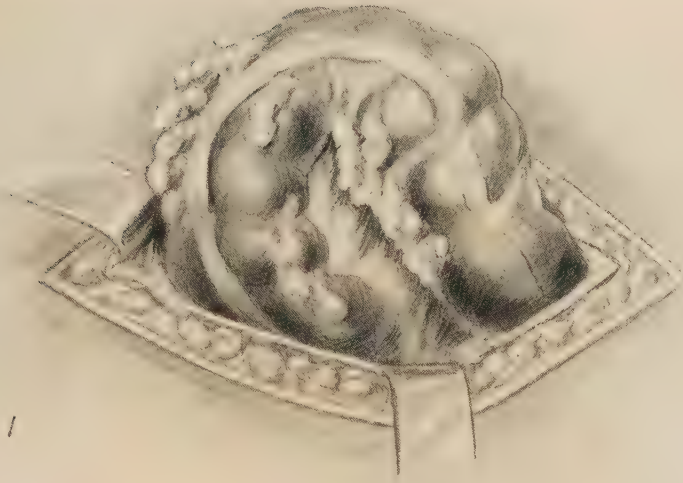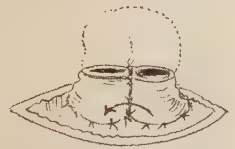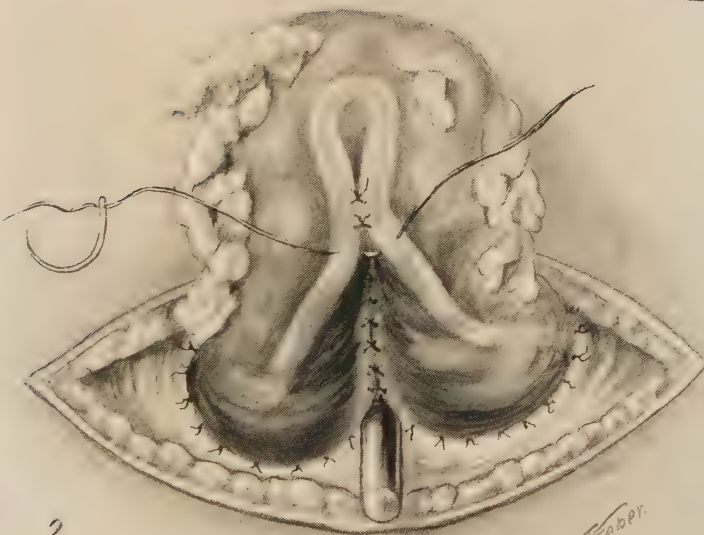
In 1 the mobilized cancer-bearing knuckle of gut has been brought out through the wound. In 2 a spur is being established by two rows of interrupted Lembert fine catgut sutures. Note sutures of same type uniting base of loop with parietal peritoneum. The small insert orientates the direction of fæcal current and shows approximately the amount of bowel to be removed.

Fig. 4.
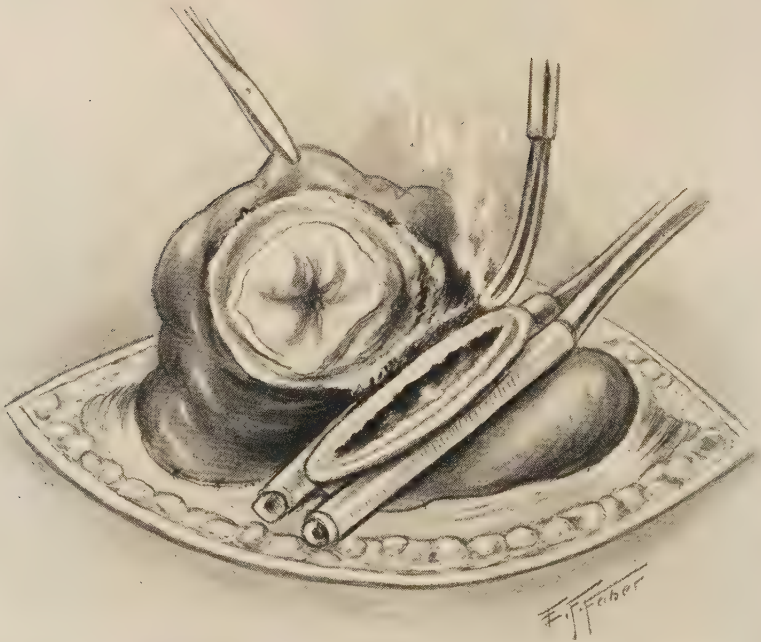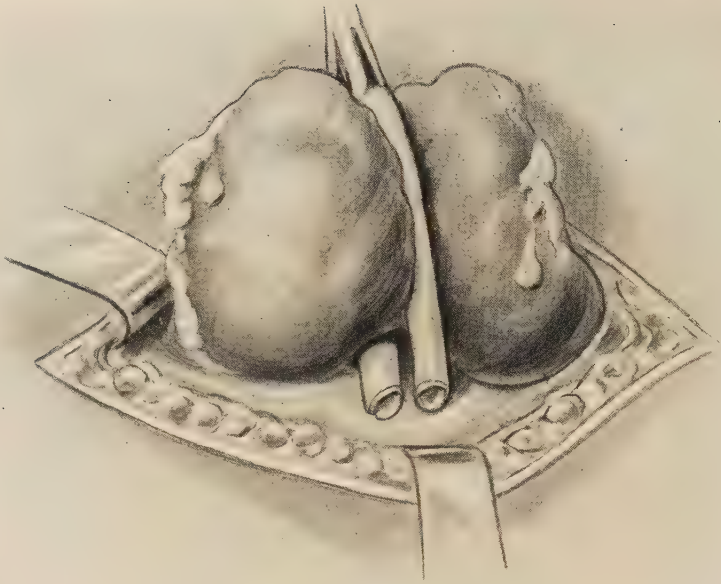
Shows the cancerous loop being removed by the clamp and cautery method.

The cæcal fistula continued to functionate while the extruded loop was being walled off from the general peritoneal cavity. Upon the fruition of this walling-off process depended the success or failure of this operation, as well as the protection of the patient from infective peritonitis. To this end the amputation of the loop was postponed four days, although by tying a strong silk ligature around each segment of the loop the cancer mass could have been ablated immediately. In this case there was no indication for establishing a gas vent in the proximal segment, because of the presence of the cæcal fistula.

Operation No. 4 (May 24, 1920).—Mikulicz second stage. No anæsthesia. Using the Paquelin cautery the segment of bowel distal to the cancer mass was divided (Fig. 4). A purse-string of silk was placed around the proximal segment, and the latter was divided with the cautery between the purse-string and the cancer mass; the latter was now free and was removed, together with the adjacent wedge-shaped area of mesosigmoid. Into the proximal segment—before a peristaltic wave could soil the field—there was placed one end of an inch Paul glass tube, the silk purse-string was tied—making the tube mechanically a part of the bowel—and to the other end of the tube there was adjusted a length of rubber hose of similar diameter (Fig. 2B). In a few moments the glass tube showed semisolid fæcal matter, which was ejected into it by the peristalsis of the proximal segment. The divided end of the distal segment was allowed to fall back in the wound without anything further being done to it. The wound was dressed with dry gauze, and the end of the rubber tube was placed in a glass male urinal bottle. At the end of the operation the patient was in excellent condition.

The colon, overloaded with the accumulation of many weeks, now began to empty itself through the Paul glass tube. The semisolid content alone would pass through the tube, however, and on the fourth day after operation the tube slipped out; it was not replaced, as the exposed tissues of the wound had by this time coffer-dammed themselves against infection. The solid fæcal residue now began to be extruded from the free end of the proximal segment; from this time on it took the bowel two weeks to empty itself of the accumulated fæcal masses, and at the end of the fortnight nothing but clear mucus appeared at the orifice of this segment.

It was now thought that the proper time had arrived for the

clamping of the spur. A three-inch clamp was placed on the spur (Fig. 5), to be tightened one notch of the handles every day; by the end of two and one-half days the clamp lay free and was removed, and the continuity of the posterior wall of the bowel was thereby restored. The opening in the anterior (superficial) wall of the bowel was still very wide, but as time went on this opening gradually became smaller and smaller. The supporting silk suture beneath the cæcum was now removed, and with the lapse of time the cæcum gradually withdrew itself into the iliac fossa, the fistulous orifice on its anterior wall

FIG. 5.
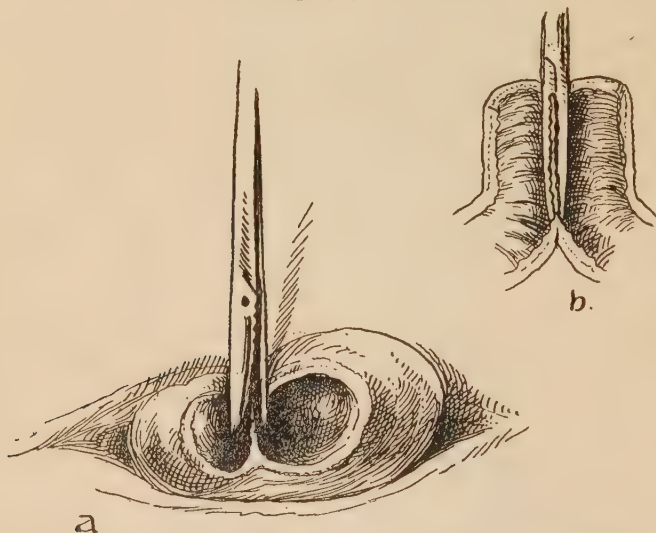
Shows how the spur between the proximal and distal barrels is destroyed by pressure necrosis of a clamp. The upper mucosa edges often unite spontaneously, or may be closed by simple suture.

remaining just below the level of the skin. As the cæcum sank deeper and deeper the spur on the posterior wall smoothed itself out and eventually disappeared, so that the intestinal contents were able to gain the ascending colon, yield up their water in the colon, and appear as formed stools, escaping in part through the fistula in the sigmoid and in part through the anus. For a time prolapse of the mucosa of the cæcum through the fistula caused some annoyance, but this was controlled by a plano-convex metal disk securely strapped over the fistula.

The patient was sent home on July 7, 1920—about two months

from the time of her admission. Her condition was very satisfactory. Her appetite was good, and she was able to partake of all varieties of food. She had gained flesh and enough strength to walk about the room. The cæcal fistula was controlled by the disk, and the sigmoid fistula was gradually becoming smaller and smaller. If, after the lapse of a reasonable amount of time, these fistulæ do not close spontaneously, as occurs in so many of these cases, they will be closed by an operation under local anæsthesia. At the time of the present writing the patient is having regularly one stool a day and is comfortable and happy.

A marked feature of this case was the great disproportion in size between the dilated proximal segment of bowel and the contracted distal segment, after resection of the cancer-bearing loop. Gradually, however, the proximal segment became reduced in calibre until it approached that of the distal.

Mikulicz in his paper (*loc. cit.*) contrasts the 42.9 per cent. mortality of the one-stage resection method followed by primary intestinal suture with the 12.5 per cent. mortality of the two-stage resection method that he himself employed. The two deaths in the latter series resulted from marasmus due to carcinoma metastases and rupture of a descending colon that was infiltrated with cancer.

The development of the Mikulicz operation is interesting. Schede, Gussenbauer, Maydl, Volkmann and others, seeing the technical impossibility of uniting the bowel ends by suture after resection of the tumor, as well as the rapid termination of the operation due to the precarious condition of the patient, concluded the operation with a preternatural anus which, when conditions permitted, could be closed later. Other combinations were also employed, for example, in the presence of ileus a preternatural anus was made above the site of stenosis, followed later by resection with typical suture of bowel. Again, primary entero-anastomosis with partial or complete exclusion of the involved segment of bowel, followed later by extirpation of the tumor. But these methods did not wholly protect the patient from the danger of primary and secondary infection of the peritoneum. The danger of infection of the peritoneum by these methods was eliminated by the two-stage operation employed by Mikulicz in practically all tumors of the large bowel encountered by him in the five years preceding the appearance of his paper, the principles of which

are as follows: As in the one-stage resection the tumor is freed of all its connections as far as the loop that binds the proximal segment of bowel with the distal. The tumor thus mobilized is brought out upon the surface of the abdomen through the incision, which is closed to the point of emergence of the two bowel segments, and the tumor is resected extraperitoneally either immediately or after the lapse of from 12 to 48 hours. The resulting preternatural anus is later closed.

A procedure based upon the above principles was first employed by Oscar Bloch, of Copenhagen, in 1892. Bloch found as the etiologic factor in a case of ileus a freely movable tumor in the sigmoid flexure. He brought the tumor together with the long mesosigmoid out upon the surface of the abdomen and incised the bowel above the tumor. After disappearance of the manifestations of ileus he performed extraperitoneal resection, which was followed after the lapse of four months by closure of the preternatural anus by circular intestinal suture. Bloch recommended this procedure only for intestinal tumors with freely movable mesentery and expressed the opinion that the greatest danger of the operation was removed by extra-abdominal resection of the bowel. Two years later Bloch went a step further in that, in a slightly movable tumor of the descending colon, he mobilized it sufficiently by incising the point of junction between the root of the mesentery and the peritoneum. Whether or not Bloch went still further and resected the mesentery primarily, as was done by Mikulicz, is not known; at any rate, he approached this step very closely. The disadvantage of Bloch's method was that by leaving the mesentery the regional lymph-nodes were left remaining undisturbed. In addition to Bloch other surgeons later employed in isolated cases a similar procedure, among whom were Allingham, W. Edmunds and Hochenegg, while De Bovis mentioned eight operations of this type, all with favorable outcome.

In detail, the Mikulicz operation is performed as follows: As in the one-stage resection the intestinal tumor, together with the involved lymph-nodes and the corresponding portion of mesentery, is freed from all connections, so that finally it remains in connection only with the proximal and distal segments of bowel. The mesentery must be so widely loosened that the portion of bowel to be removed can be placed upon the surface of the abdomen without undue tension. When this is accomplished the abdominal wall is closed up to the emergence

of the proximal and distal segments of bowel; this space must not be too narrow, lest the proximal segment of bowel be compressed. At the point of contact of the parietal peritoneum with the emerging segments of bowel a row of serous sutures is placed, which also closes the peritoneal cavity at this site. The skin is accurately sutured up to the emerging segments of bowel. No drainage is employed. The suture line as well as the surface of contact between the loop of bowel and the skin is now thickly covered with zinc-oxid ointment, over which a dressing of sterile gauze is placed. Over this dressing there is placed a large piece of rubber dam with a slit just large enough to allow the loop of bowel to come through it. In this way the loop of bowel with the tumor to be resected is separated from the peritoneal cavity both by the sutured peritoneum and the protective dressing. In his early cases Mikulicz removed the tumor after the lapse of from 12 to 48 hours, but later he removed it immediately. In the proximal segment of bowel a large glass tube is introduced and secured by a purse-string, and to this is attached a large rubber tube, through which the intestinal contents escape.

In this procedure the abdominal wound heals as far as it is sutured almost invariably by first intention. The artificial anus resulting from removal of the tumor is changed after 2 or 3 weeks by means of a Dupuytren clamp into a fæcal fistula, which later is closed by suture.

The disadvantages of prolonged treatment and the inconvenience of an artificial anus are more than counter-balanced by the greater safety and ease of performance.

J. B. Murphy, in 1915, performed the Mikulicz two-stage operation in a case of peridiverticulitis of the sigmoid flexure. His patient was very fat, and Murphy stated that the obese type of patient offers a poor surgical risk and does not stand the one-stage operation well ("The Clinics of John B. Murphy," February, 1916, Vol. V, No. 1, p. 31).

C. H. Mayo, in 1904, introduced the Mikulicz operation into the Mayo Clinic. W. J. Mayo, commenting upon this method in 1916, stated that it has probably done more to extend operability and reduce mortality than any other factor (*Jour. Amer. Med. Assoc.,* 1916, lxvii, 1279–1284). Continuing, Mayo says the operation of Mikulicz can be applied to very low growths; it is astonishing to what extent even the upper part of the rectum can be brought into the

abdominal wound. On many occasions he has removed rectosigmoid growths in this way, separating the rectum within an inch of the anus, and by loosening and depressing the parietal peritoneum, has succeeded in maintaining the growth exterior to the abdominal cavity.

C. N. Dowd, in 1920, in a paper entitled " The Advantages of the Mikulicz Two-Stage Operation of Partial Colectomy" (*Annals of Surgery,* February, 1920, Vol. lxxi, No. 2, pp. 155–162) states that many surgeons have adopted this operation on account of its diminished mortality rate. He adds that the colon from the hepatic flexure to the terminal sigmoid is the region for which the two-stage operation is especially considered. This region furnishes nearly 70 per cent. of the intestinal cancers above the rectum. Here we have an intestinal content which is semisolid, or possibly solid. It holds vast numbers of bacteria—from one-quarter to one-third of the stool bulk is due to bacterial growth. Partial obstruction exists in a large proportion of the cancers of this region which come to operation, hence this septic intestinal content cannot be satisfactorily eliminated and forms a serious menace to satisfactory healing.

Continuing, Dowd states that the peritoneal covering is frequently defective. This defect in the upper part of the descending colon is due to the anatomical arrangement which usually leaves the posterior portion of the gut uncovered by peritoneum. However, the deposit of fat between the peritoneum and the muscular coats of the intestine is sometimes the main barrier to satisfactory serous apposition. In the sigmoid and descending colon one frequently notices at operation that the strip of peritoneum which lies close to the muscular wall is only one-half to three-quarters of an inch in width and that there is a thick deposit of fat elsewhere. This fat deposit is shown in the appendices epiploici, but in many instances is massive and really envelops a large part of the intestinal wall. Of course, in those patients who are debilitated by cancer it has usually been absorbed, but some patients come to operation in whom it is still present, hence operation must be planned with the understanding that fat deposit may hamper serous apposition of the divided intestinal ends.

" The condition of the patient may be a strong barrier to a successful one-stage operation. The majority of these patients suffer from cancer and have suffered for a long time before they come to

operation. They have little resisting power and hence operative
procedure must be planned so that they will not have more than
they can endure.

" Peritoneal sepsis does not often come in these patients, but a
perforation is occasionally found which leads to considerable peri-
toneal sepsis and hence forbids a type of anastomosis which other-
wise might be made.

" The interference with nutrition, the skin irritation and the
reflex effect of fastening the intestine to the abdominal wall are all
minimized in the two-stage operation on the colon as compared with
the small intestine. We therefore have many reason why a two-stage
operation should be used in a large number of partial colectomies."

J. A. Hartwell, in 1917 (" Carcinoma of the Splenic Flexure
of the Colon," *Annals of Surgery,* September, 1917, lxvi, pp. 339–
361), states that his collected cases show a mortality three times
greater in the one-stage than in the many-stage procedure. " Careful
study indicates that the failures in the one-stage operation would have
been avoided by the other mode of attack. These failures arose almost
entirely from leakage somewhere along a suture line, with a resultant
peritonitis or improperly drained abscess."

The late James P. Tuttle once told Dowd that he had successfully
done five successive partial colectomies by the Mikulicz method,
whereas his previous mortality rate, in similar conditions by other
methods, had been 33 per cent.

Dowd reported eight cases of which the mortality rate—one in
eight—is much better than that obtained by immediate suture. Of
these eight cases six were cancers of transverse, descending or sigmoid
colon; one was extensive tuberculosis of caput coli and lower ileum;
and one was diverticulitis of descending colon with perforation and
abscess formation, as in Murphy's case.

As to the applicability of the one-stage procedure he states that,
without doubt, there are patients in whom the one-stage operation
can be successfully done. Such patients should be fairly strong and
their colons should be nearly empty and should be comparatively free
from fat. Before deciding to use this method, one may well remember
the brilliant results which Mayo and Mikulicz have obtained by the
two-stage procedure, and Hartwell's studies which show that the
one-stage procedure has had a mortality rate three times greater than

the many stage method. It is not Dowd's purpose to advocate the two-stage procedure for all cases, but rather to call attention to its advantages and to urge its use in the average case as it now comes to us in the hospital, reserving immediate suture in the colon for those patients who are especially fitted for it.

A. D. Bevan, in 1920 (*Surgical Clinics of Chicago,* April, 1920, Vol. iv, No. 2, pp. 311–319*), performed the Mikulicz operation in a case of carcinoma of the splenic flexure. He does not like, however, to resort to the Mikulicz operation. He prefers to perform primary radical resection or colostomy and radical resection with final closure of the colostomy wound to the Mikulicz operation. He thinks, however, that conditions do arise, as in the case he presents, in which the Mikulicz operation is the preferable procedure.

From the report of the writer's case and this incomplete review of the literature it will be seen how safe a procedure the Mikulicz two-stage operation is in lesions of the large bowel that would be ugly to deal with by the one-stage method. The employment of local, instead of general, anæsthesia where possible still further increases the margin of safety by minimizing shock and avoiding the undesirable sequelæ of general anæsthesia.

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* See also Bevan, "Surgery of Cancer of the Large Intestine," *Jour Amer. Med. Asso.*, vol. lxxv, July 31, 1920, p. 283.

Medicine

INTERESTING CASES IN WHICH A SO-CALLED CHIARI'S NET WAS FOUND IN THE RIGHT AURICLE OF THE HEART, WITH OR WITHOUT THE PRESENCE OF ANY OTHER CONGENITAL CARDIAC ABNORMALITY

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A so-called "Chiari's net" or "reticulum of Chiari" is the abnormally persistent remnant of a normal structure in the right auricle of the human fœtal heart. The first thorough account and explanation of the presence of these nets is due to H. Chiari in 1897,[1] who showed that they were nearly always derived from, that is to say, they were vestigial remnants of, the fœtal *septum spurium*, namely, the portion of it constituting the *valvula venosa dextra* (the valve of the right venous sinus). Very rarely the fœtal *valvula venosa sinistra* (the valve of the left venous sinus), may also be represented by a net in adult life. The typical Chiari's net, that representing the *valvula venosa dextra,* is found attached to the Eustachian valve and, by one or more threads, to the heart-wall in the region of the *tuberculum Loweri* and the *crista terminalis;* it may likewise be attached by a thread or two to the interauricular septum.

A Chiari's net is very seldom observed at post-mortem examinations, but doubtless would be oftener found if methodically and regularly looked for. Its presence—which, needless to say, can never be detected during life—is scarcely likely to exert any harmful influence on the health of an individual, but it is apt to be associated with other congenital cardiac abnormalities, which may, directly or indirectly, lead to premature death. This happened in the case of

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[1] H. Chiari, "Ueber Netzbildungen im rechten Vorhofe des Herzens," Ziegler's *Beiträge z. path. Anat. u. z. allg. Path.*, Jena, 1897, vol. xxii, pp. 1–10.

a man (whose heart I saw), described by H. Ebbinghaus in 1904.[2] Moreover, though very rarely, thrombi may form on a Chiari's net during life—which may give rise to pulmonary embolism—as in Chiari's first case and in a case described by Looser in 1902.[3]

I have come across a Chiari's net quite recently in post-mortem examinations on two interesting cases, in only the first of which was there any other congenital cardiac disease associated with it. But before describing these cases I will summarize the above-mentioned case published by Ebbinghaus in 1904.

The patient was a man (C. W.), aged fifty-two years, who died in 1903, in the London German Hospital, about ten hours after having fallen down senseless in the street. The cause of his death was hemorrhage in the right basal ganglia of the brain, which had burst through into the right lateral ventricle. He was a big man, with high-colored face, and without any history of syphilis or alcoholic excess. He had been subject to repeated attacks of bleeding from the nose, and 14 years previously (at the age of thirty-eight years) he had had a severe stroke of apoplexy, which necessitated his remaining several weeks in bed. Two years after that (at the age of forty years) he was attacked with a second " stroke," which was accompanied by right hemiplegia and affection of the speech. This obliged him to remain for several months in a hospital, but he slowly recovered. During the final attack, which killed him, left hemiplegia was observed.

At the post-mortem examination, apart from the cerebral hemorrhage, which was the direct cause of death, the interest centred in the heart. One may add that there was evidence of a previous cerebral hemorrhage, on the outer side of the *left* nucleus lenticularis, that there was a " nutmeg-liver " and that there were biliary calculi in the gall-bladder.

The size of the heart was at least the triple of the normal and in this connection it should be mentioned that during life no abnormal cardiac sound had been made out by auscultation, and the urine had been found free from albumin and sugar. The ventricles and the

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[2] H. Ebbinghaus, " Zur Kasuistik der Kongenitalen Herzfehler und deren Möglichen Folgen," *Muenchener Med. Wochenschrift*, 1904, li, pp.797–800.

[3] Looser, " Ueber die Netzbildungen im rechten Vorhofe des Herzens " (Trang. Dissert.), Zürich, 1902; quoted by Ebbinghaus, *loc. cit.*

auricles were hypertrophied and dilated, but it was the powerful musculature of the right ventricle which was especially noteworthy. The coronary arteries were somewhat sclerosed. No decided valvular disease was present, and there was no patency in the interventricular septum; but the interauricular septum—which was entirely membranous—had numerous foramina in it, which doubtless necessitated great hypertrophy on the right side of the heart to balance the pressure from the left side. The ductus arteriosus Botalli was normally closed.

There was a " Chiari's net " in the right auricle, of the typical kind, attached to the free edge of the Eustachian valve and to the neighborhood of the *tuberculum Loweri* and *crista terminalis,* between the orifices of the two venæ cavæ (see the illustrations accompanying Ebbinghaus's description). This net evidently represented —that is to say, was derived from—the fœtal *valvula venosa dextra.*

With regard to the abnormal interauricular septum, the two largest foramina in it represented respectively a patent *foramen ovale* or so-called *ostium secundum* of Born, and a persistent *ostium primum* of Born [4]—the former being anterior to the latter. The whole interauricular septum was membranous (instead of being partly muscular), because it was doubtless entirely derived from the fœtal *septum primum;* there was no trace of any *septum secundum,* from which normally the *limbus Vieussenii* (*annulus Vieussenii*) and the muscular border of the interauricular septum are derived. In fact, Ebbinghaus points out that, according to Born's researches on the development of the mammalian heart, the stage of development of the interauricular septum in the case in question corresponded to that found in a rabbit-embryo of about 13 or 14 days. Ebbinghaus explains the presence of the numerous smaller foramina in the septum (there were thirteen minute foramina, besides two larger ones, which represented respectively Born's *ostium primum* and *ostium secundum*) as an example of the persistence in a human being of a stage of development which rarely (Röse)—that is to say, only abnormally—occurs in human embryos, but occurs normally in the

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[4] Many years ago there was a post-mortem examination at the hospital in which a persistent *ostium primum* of Born was found, the *foramen ovale (ostium secundum)* being normally closed.

embryos of some animals (birds, according to Lindes; also marsupialia and monotremata).

In regard to the clinical history of the patient in question, Ebbinghaus explains the tendency to epistaxis and to cerebral congestion—the latter of which led to attacks of cerebral hemorrhage at the early age of thirty-eight years and forty years respectively, and finally to the fatal apoplexy at fifty-two years of age—as the result of the dilatation and hypertrophy of the right side of the heart due to the abnormal communication between the two auricles. In fact, he regards the congenital imperfection of the interauricular septum as being the indirect cause of the fatal cerebral hemorrhage. The occurrence of the latter could not be accounted for by the more usual causes: arteriosclerosis (there was no macroscopic disease of the arteries at the base of the brain), syphilis, gout, alcoholism, and renal disease.

I will now proceed to the two cases I have recently observed.

CASE I.—The first of the two patients was a man (A. M.), aged twenty-nine years, who died on February 10, 1920, with signs of chronic malignant endocarditis. There was a doubtful history of rheumatism at the age of seven years; no evidence of syphilis. He had complained of dyspnœa on exertion at least as far back as the year 1908, and was an in-patient at the German Hospital for a week in that year (October 1st–8th). At that time a systolic thrill could be felt with the hand, over the whole cardiac area, and a corresponding loud systolic murmur could be heard by auscultation. The cardiac apex-beat was in the left sixth intercostal space, one finger's-breadth inside the nipple line. The pulse was about 60–70 per minute, small, soft, slightly irregular. There was no cyanosis or œdema. There were then no signs of any lung disease. The urine was free from albumin and sugar. The blood-count gave 5,480,000 red cells and 16,480 white cells to the cubic millimetre of blood; hæmoglobin 105 per cent.

In December 1919, a Röntgen-ray photograph of the heart was taken and showed great enlargement of the right auricle and some enlargement of the left auricle (Dr. Finzi). Pulmonary stenosis was never definitely diagnosed, although it was suggested as present, together with mitral valve disease, during the winter 1909–1910. The murmur (which was then heard immediately after the first

sound, between the first and second sounds) was most distinct or loudest over the sternum at the base of the heart, and over the pulmonary area. By palpation at the base of the heart a thrill could be felt, directly following the cardiac beat. Pulsation could be seen by ordinary inspection over the same region. About that time the face was said to be redder than it formerly used to be. He appeared somewhat cyanotic and dyspnœic. He said he suffered from chilblains every winter. There were signs suggesting chronic pulmonary tuberculosis at the apex of the right lung. The blood-count gave 5,780,000 red cells and 16,480 white cells to the cubic millimetre of blood; hæmoglobin 105 per cent.; microscopical examination of a blood-film showed nothing special. There was no " clubbing " of the fingers.

The patient was readmitted to the hospital ten years later, on December 23, 1919, and from that time to his death (on February 10, 1920) he presented the clinical picture of a case of subacute malignant endocarditis, with irregular pyrexia and occasional rigors. There was a loud systolic murmur heard over the cardiac apex and, especially loud, over the sternum. There were general bronchitic signs, and there was dulness to percussion over the upper front of the right lung, suggesting pulmonary tuberculosis. Röntgen-ray examination of the thorax (Dr. James Metcalfe, December, 1919) showed considerable opacity of the upper lobe of the right lung, and the right auricle appeared to be enlarged. The pulse was frequent, of rather low pressure (brachial systolic blood-pressure 96–110 mm. Hg.). The Wassermann reaction (December, 1919) was negative. The urine (specific gravity, 1008–1020) generally contained a trace of albumin; no sugar. Digitalis, nux vomica, diuretin, quinine, and some other drugs, were tried, but naturally without averting the fatal event.

At the *necropsy* (February 11, 1920), the heart and great blood-vessels at the base of the heart were of course the main objects of interest, but to these I will return. Lungs: old fibro-caseous tuberculosis of the apical portion of the right lung. In both lungs there were patches of what seemed to be remains of old embolic infarctions. The right pleura was almost completely adherent. The left pleura contained a moderate amount of serous effusion. The liver was

enlarged and of the nutmeggy kind. The spleen (weight 6 ounces) was of medium size and somewhat fibrotic. The kidneys (weight together 11 ounces) were, to naked eye examination, not obviously diseased. Nothing else special was noticed elsewhere as far as our rather incomplete examination went. I shall now return to the description of the heart.

The *heart* as a whole was not much enlarged and weighed only 12 ounces, but the musculature of its right side was greatly hypertrophied, the wall of the right ventricle being actually thicker than that of the left. The right auricle was much dilated and much hypertrophied, so that it had thicker walls than the left auricle. The left side of the heart was normal. On the right side there were old (ante-mortem) hard, pale, thrombotic masses attached to the *chordæ tendineæ* of the tricuspid valve; and thrombotic masses projected through the tricuspid orifice into the right auricle. Owing to the kindness of Professor S. G. Shattock some of this pale material was examined microscopically for tubercle bacilli, but with negative result. The pulmonary orifice was contracted and all the three semilunar cusps were greatly thickened—there was, in fact, congenital pulmonary stenosis, possibly as a result of intra-uterine endocarditis. The ductus arteriosus Botalli was closed; so was the foramen ovale, and there was no perforation (patency) either in the interauricular septum or in the interventricular septum. Of great pathological importance was the fact that in the pulmonary artery, between its commencement and its bifurcation, there were adherent (ante-mortem) thrombi.

The case was, therefore, one of congenital disease of the right side of the heart, affecting the pulmonary and probably also the tricuspid orifices. On this basis of congenital pulmonary stenosis, and probably also tricuspid disease, malignant endocarditis of the tricuspid valve had supervened, as the result of some infection, such as tonsillitis, etc. In addition to the infection of the endocardium of the right side of the heart the inner coat of the pulmonary artery was likewise attacked, so that there was a condition of *malignant endarteritis of the pulmonary artery* as well as of malignant endocarditis of the tricuspid valve. In regard to the malignant endarteritis of the pulmonary artery I may refer to a paper by Dr. K. Fürth and myself (1905) on " Malignant Pulmonary Endarteritis after

Gonorrhœa, Simulating Disease of the Pulmonary Valve." [5] In that paper the analogous condition of malignant aortitis is likewise alluded to.

As to the tuberculous affection of the right lung I need only point out that it manifested itself in the interval between October, 1908, and December, 1909, when the patient was admitted for the second time to the hospital; but it evidently afterwards became chronic or quiescent in spite of the presence of the congenital cardiac disease (pulmonary stenosis), which, one would have supposed, was likely to favor its development, by interfering with the proper blood-supply to the lungs.

It is highly probable that the auscultatory phenomena supposed during the patient's life to be due to mitral disease, were really due to the pulmonary stenosis or to that and tricuspid incompetence combined.

I have purposely not yet mentioned the "Chiari's net" in the right auricle, which was found at the post-mortem examination. It was of the characteristic kind (as described at the commencement of this paper), attached to the free edge of the Eustachian valve, and doubtless derived from (that is to say, was a vestigial remnant of) the fœtal structure known as the *valvula venosa dextra* (the valve of the right venous sinus).

I have to thank Professor S. G. Shattock for his kind help in the pathological examination of this case and for his advice in regard to the drawing of the two figures by Mr. S. A. Sewell. Fig. 1 shows the right ventricle and pulmonary artery opened up. The pale hard (ante-mortem) masses attached to the chordæ tendinæ are well pictured, and so are the thickened congenitally-diseased semi-lunar valves of the pulmonary orifice. In the pulmonary artery, between its origin and its bifurcation, the ante-mortem adherent thrombi are seen. Fig. 2 represents the heart, with the right auricle opened up and the ante-mortem adherent thrombotic mass projecting from the tricuspid orifice. There is an elaborate Chiari's net attached below to the free border of the Eustachian valve. Part of its other attachments was torn at the necropsy, but this has been carefully put together by Professor Shattock, as shown in the figure.

[5] K. Furth and F. Parkes Weber, *Edinburgh Medical Journal*, 1905, New Series, vol. xviii, p. 33.

CASE II.—In the second case the Chiari's net in the right auricle (see description further on) was found at the post-mortem examination, unaccompanied by any other cardiac abnormality.

I first saw the patient (J. K.), when he was aged thirty-three years, on March 1, 1918. He was suffering from severe hæmaturia of unknown origin. There was a history of three previous attacks of hæmaturia, the first of which occurred about December, 1916; each attack had lasted three or four days.

The hæmaturia on this occasion (the fourth attack) soon passed off. On March 7, 1918, the urine appeared practically free from blood to naked-eye examination, but microscopical examination showed the presence of numerous pus-cells and a few erythrocytes; there was considerable albuminuria, but no tube-casts were found. The patient was weak and anæmic, owing to the large amount of blood that he had lost. Röntgen-ray examination (Dr. James Metcalfe) pointed to the left kidney being probably enlarged, but gave no evidence of calculus in the bladder, ureters or either kidney. The brachial systolic blood-pressure was 110 mm. Hg. The Wassermann reaction was negative (this was confirmed by later examinations).

About the middle of March the urine still showed a good deal of albumin; the centifuge-sediment was free from tube-casts, but contained red and white cells, and some pear-shaped epithelial cells, that might be derived from the renal pelvis. My surgical colleague, Mr. A. Compton, catheterized the ureters. The urine obtained from the left ureter was turbid and contained white cells and a few erythrocytes; that from the right ureter was clear and showed nothing special by microscopical examination. On April 1st the urine was again temporarily red with blood. From April 19th to April 29th there was considerable hæmaturia, very severe on April 22nd, when the urine resembled pure blood and was passed with difficulty.

On May 18, 1918, the ureters were again catheterized by Mr. Compton. The specimen of urine from the right ureter was clear and free from albumin; that from the left ureter was turbid with pus-cells and contained a good deal of albumin. The disease was therefore in the left kidney, but the patient refused any operative interference.

In June, 1918, owing to some mistake, the patient was forced to

Fig. 1.
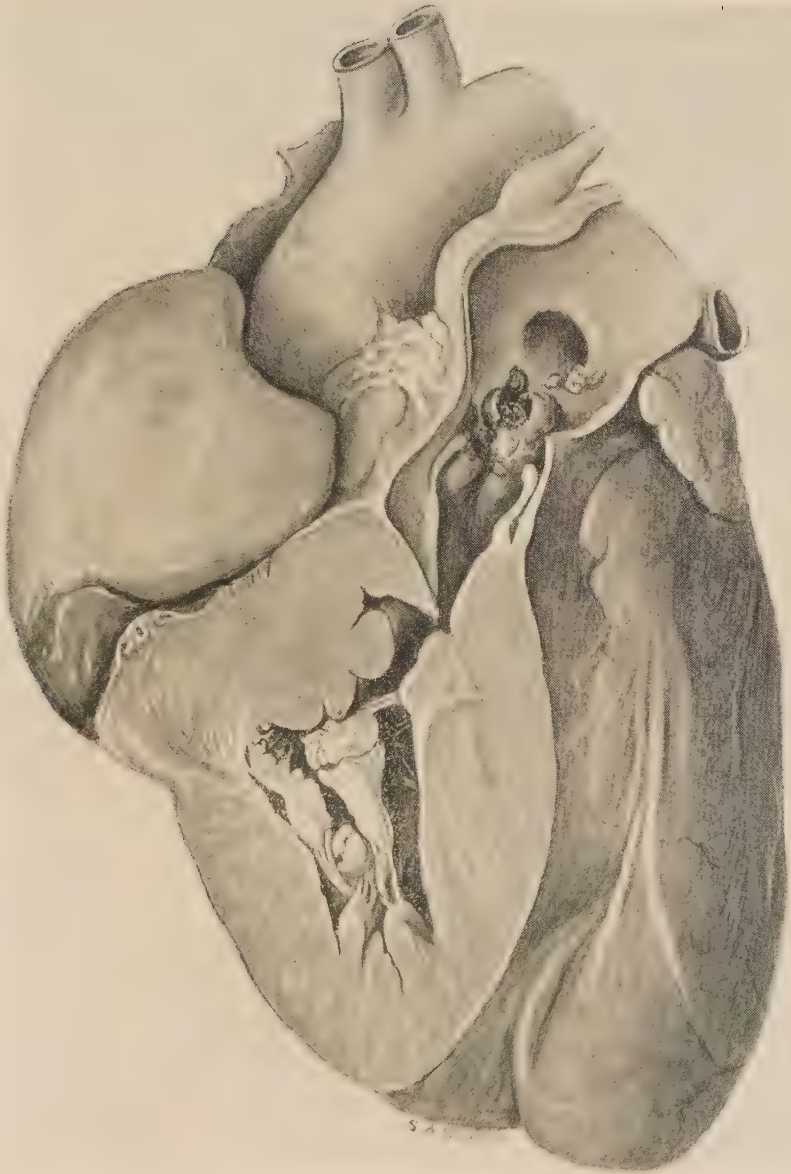
To show the right ventricle and the disease of the pulmonary valve and pulmonary artery in Case A.

Fig. 2
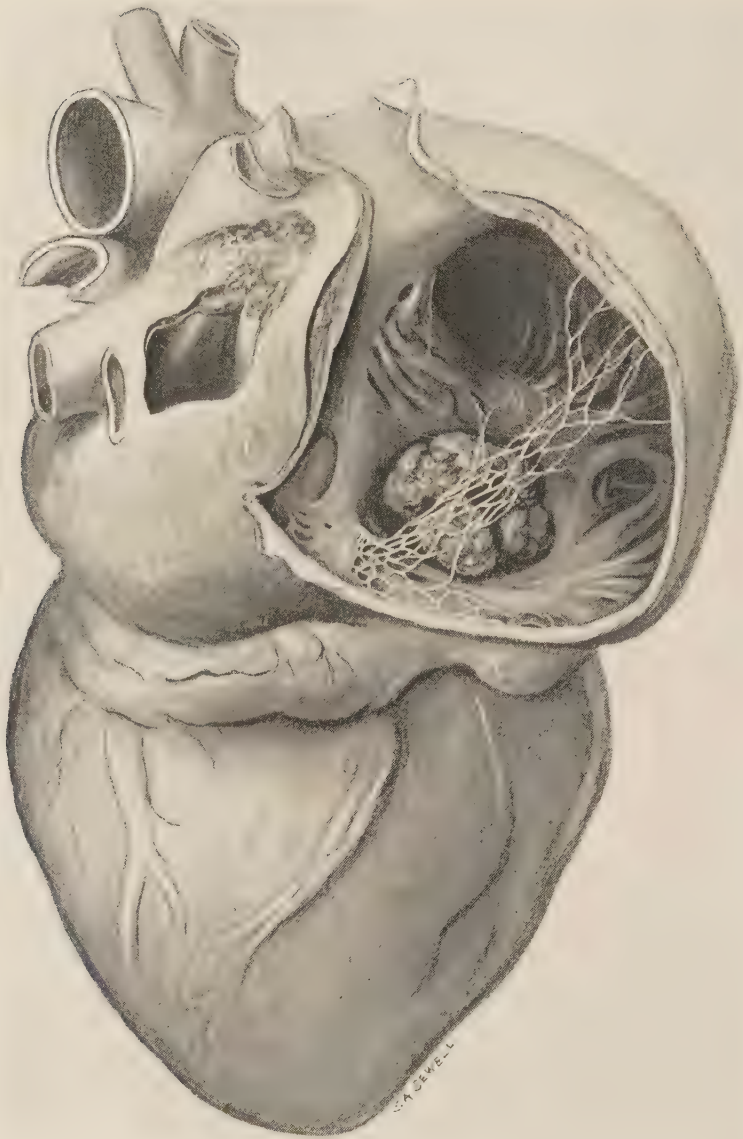
To show the right auricle with the diseased tricuspid orifice and the Chiari's net in Case A.

Fig. 3.
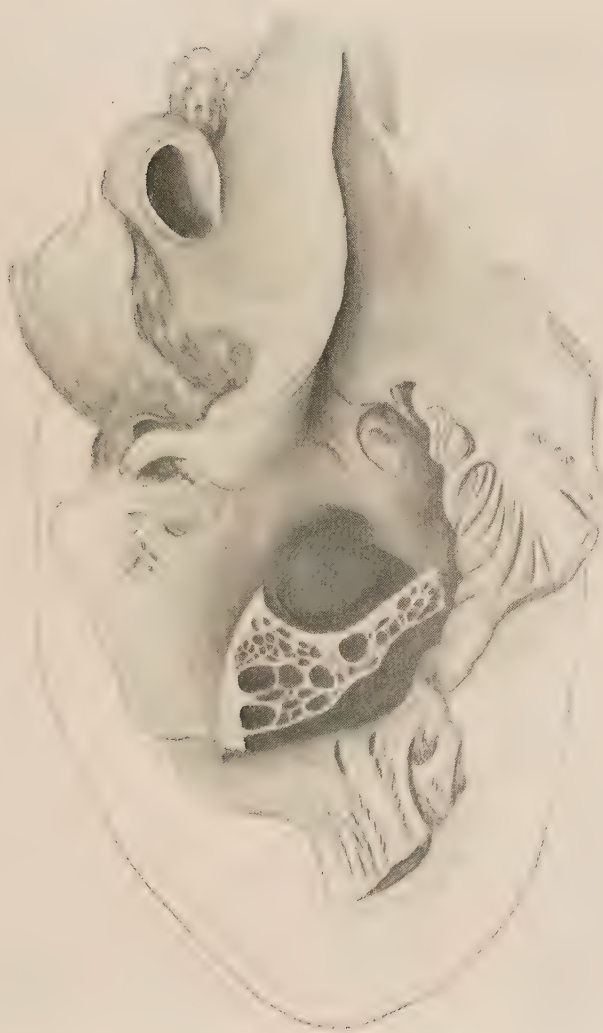
To show the Chiari's net in the right auricle from Case B.

enter the army, but was soon transferred to a military hospital, where great attention was given to him, and he was afterwards set free.

In August and at the commencement of November, 1918, he again suffered from attacks of hæmaturia.

On February 21, 1920, he was readmitted to the German Hospital with a pleural effusion on the left side, which was tapped on the following day and found to be sero-sanguineous. The urine contained a little albumin, and red and white blood-cells, but no tube-casts. The left pleura had to be tapped again on February 26th. The patient was extremely feeble and died on March 1, 1920.

The *post-mortem examination* showed a cauliflower-like mass of new growth, projecting into the dilated pelvis and calices of the left kidney; owing to the chronic pyonephrosis on that side none of the renal glandular substance remained. The left suprarenal gland was apparently replaced by a mass of tumor, of about the size of a small orange. There were secondary tumors in the left pleura and left lung, and likewise in the right pleura. The right kidney was macroscopically not diseased, but (compensatorily?) somewhat enlarged. The liver was bulky, weighing 87 ounces, and having an appearance of fatty infiltration. Some of the retroperitoneal lymphatic glands near the diaphragm were infiltrated with tumor. Microscopical examination of the (primary?) growth about the left kidney and of a secondary growth from the left pleura showed the tumor to be sarcomatous, with irregularly-shaped cells.

I have again to thank Prof. S. G. Shattock for his kind help in regard to the pathological examination of this case and for his advice in regard to the illustration (by Mr. S. A. Sewell). Fig. 3 shows the right auricle (opened up), in which is an elaborate " Chiari's net " connected with the free border of the eustachian valve. The attachment of the other end of the net has been unfortunately broken, but it was probably attached to the region of the *tuberculum Loweri* and the *crista terminalis*. The heart from this case, as well as that from the preceding case, is now in the Museum of the Royal College of Surgeons, London.

FATAL MENINGITIS FOLLOWING INJURY

By I. A. LEDERMAN, M.D., F.A.C.S.,

AND

B. F. ZIMMERMAN, M.D.
Louisville, Kentucky

CLINICAL AND AUTOPSY FINDINGS: DR. LEDERMAN

MR. C. B., aged thirty-two years, a resident of southern Indiana, came under my observation November 2, 1919, less than twenty-four hours after receiving an injury to his right eye, a first-aid dressing having been applied.

According to the history obtained, the patient was sitting on the floor under a table working with a screw-driver, using both hands and exerting considerable pressure in applying a screw slightly above the level of his eyes. For some unknown reason the screw-driver slipped and (as he thought) penetrated his eyelid just above the eyeball.

At my first observation, and this is an interesting and sad feature, the injury presented an innocent appearance. There was nothing to indicate that the patient had sustained anything but a small superficial wound of the eyelid. The wound was located near the inner margin of the right upper lid and apparently consisted of the pulling loose of a small tongue-shaped flap of skin. There was no swelling, no redness and no evidence of infection. The attention he received at the time was simply cleansing of the wound and the application of three superficial sutures reattaching the skin flap. Late that evening the man's wife telephoned that he was suffering pain and the eyelid was swollen. I told her to apply hot compresses and send the patient to see me the next morning.

When he appeared Monday, November 3rd, the eyelid was swollen, œdematous, the skin flap had separated, and he apparently had an infection of the eyelid. There was absolutely no evidence of orbital

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involvement at that time; the eyeball was not displaced in any direction, it did not protrude, and the eye movements were normal. His temperature at the time was about 100° F.; the patient looked ill; he was sallow, and said he felt badly in a general way. He was instructed to continue the hot packs and to have the family physician examine him to determine whether he needed general attention.

Tuesday morning, November 4th, the family physician, Dr. F. M. Wilcox, telephoned that the man was much improved, that the swelling had subsided, his temperature was 99° F., and asked whether I desired to see him that day. I told him no, but asked that he report the man's condition the following morning.

On Wednesday, November 5th, just four days after receipt of the injury, Doctor Wilcox telephoned that the man was much worse, that the eye was considerably swollen, œdematous, painful, and his temperature was 101° F. I saw him at his home about six o'clock Wednesday evening, at which time he had unmistakable evidence of a phlegmon of the orbit. The lid was then enormously swollen, the tissues were tense and œdematous, the eyeball was pushed downward, mobility was limited to lateral and lower movement. The eyeball could not be moved in the upward direction, and the swelling and œdema had extended downward upon the neck. The greatest point of tenderness was not at the site of the wound; it was near the outer angle of the eyelid.

The patient was brought to the Jewish Hospital, Louisville, on Thursday morning, November 6th. That afternoon, under general anæsthesia, an incision about an inch in length was made over the point of greatest swelling and tenderness, extending downward to the margin of the orbit; the periosteum was separated, and with artery forceps at a depth of about an inch an abscess was located. This was opened and explored as far as possible without exerting too much pressure, the tissues being separated with the blade of the forceps, and a large quantity of pus liberated. A cigarette drain was inserted and the patient returned to bed.

The next day, Friday, November 7th, his temperature rose to 104–5° F., and he suffered considerable pain, but there were no other symptoms. The patient was given a purge, and the wound was dressed twice that day as drainage was profuse.

On Saturday, November 8th, he passed a very comfortable day.

His temperature ranged about 100–1° F.; he had no chills; he was cheerful, and altogether felt much improved. The wound continued to drain, hot packs of magnesium sulphate were used, and the swelling had begun to subside, as shown by the wrinkling of the lid; the eyeball could be moved more freely, and it appeared as though the wound had been drained properly and sufficiently.

Sunday morning, November 9th, upon arrival at the hospital, I found the patient had passed a rather restless night. However, his temperature was no higher than the previous day, and the wound looked well. He complained of persistent headache, also pain in the back of his neck, and there was some rigidity of the neck. The man appeared exceedingly nervous and irritable. During the day he developed some twitching of the left hand. He was inclined to be "flighty" and while not actually delirious he said things which sounded as though he were trying to be "funny," and I thought that was what he was doing. The eye grounds of the uninjured were carefully examined and found normal. The injured eye could not be examined on account of the condition of the lid. A spinal puncture was made about noon that day and report received from the laboratory within an hour showed "spinal fluid turbid, an increase in cell count, but no organisms." A culture was made which later proved to be sterile.

Sunday afternoon it was fully realized that the patient was in a most serious condition and that he probably had beginning meningitis. The first thing to be considered was exploration of the orbit and establishment of free drainage. In order to accomplish this it seemed necessary to enucleate the eye, which was perfectly normal, and I therefore hesitated. Consultation was requested and the family selected Dr. S. G. Dabney, who saw the patient with me Sunday evening and agreed in my opinion that the eye should be removed and free drainage established in that way before anything else was done.

The operation was performed at four o'clock Sunday afternoon, November 9th, the eye being enucleated and was found normal. My original incision was then extended from the outer to the inner canthus, the periosteum separated from the entire roof of the orbit, and absolutely no pus was found. While slight drainage had continued until noon of that day, at the time of the operation the wound had not been dressed for four or five hours, and the dressing was dry.

except for a small amount of serum. During this operation a perforation in the roof of the orbit was discovered in an entirely different location from the point explored at my first operation. It was in the nasal and upper aspect of the orbit one and a half inches from the orbital rim, *i.e.,* above and slightly to the nasal side of the optic foramen. The opening was probably half an inch in diameter, oval in shape, the long axis being antero-posterior; it was a smooth, clean-cut perforation, not such an opening as one might expect to find in the presence of necrosis. The perforation could not be reached until after the eye had been removed.

The condition of the patient became very unsatisfactory under the anæsthetic, and we feared that he might die on the operating table. The orbital perforation was quickly enlarged with forceps and a cigarette drain inserted to the site of the injury. A dressing was then applied and the patient returned to bed. He rallied promptly, but the symptoms continued. Dr. B. F. Zimmerman saw the patient with me on Monday morning, November 10th, or ten days after infliction of the injury, and operated the same afternoon. His findings will be given later.

We were fortunate enough to secure permission to make an autopsy in this case. Examination showed a general meningitis which was more pronounced on the right side. When the brain was removed a dural opening was noted which was found to correspond to the location of the orbital perforation, and when the dura was separated a perforation of the brain tissue was revealed with bloody extravasation in that region. No pus was found in the brain tissue.

To me this case teaches some important lessons. The patient had an injury which to all appearances was innocent, one frequently seen in daily practice, *i.e.,* a superficial wound of the eyelid. Such wounds rarely give any trouble when properly dressed. Whether the extent of the injury could have been primarily determined, whether I would have been justified in making more extensive exploration when the patient first came under my observation, are questions which cannot now be answered. However, in the light of subsequent events in this case, regardless of the fact that the innocent appearance might render diagnosis of a simple injury of the eyelid almost certain, I believe every wound of this character ought to be thoroughly explored before

the patient is dismissed. Personally, I shall certainly remember this unfortunate case whenever a patient comes to me with an injury of the eyelid, no matter how innocent it may seem.

The fact is significant that *Streptococcus hæmolyticus* was found in pus evacuated from the orbital abscess, also in pus obtained from the dura and pia mater, and in the spinal fluid which was sterile on culture for organisms until the last puncture which was made at the time Doctor Zimmerman opened the skull.

Later history obtained from the family showed that the patient suffered considerable pain at the time the injury was inflicted and was supposed to have fainted. However, he quickly recovered, and when I first saw him he complained of no pain. He was a church singer and on Sunday after his eye had been dressed in my office he went to church and performed his duties as a choir singer. Therefore, he could not have been suffering much from pain. The severe pain began Sunday night, more than twenty-four hours after receipt of the injury.

It is always embarrassing to give a favorable prognosis in any case and then have death to occur within a few days from unforeseen complications.

OPERATIVE FINDINGS : DR. ZIMMERMAN

I saw this patient with Doctor Lederman November 10, 1919. At that time he presented the picture of a localized meningitis. There was left facial weakness and rigidity of the right arm. The left leg was not involved. There were no other focal symptoms.

In view of the fact that the spinal fluid was then negative, as shown by two lumbar punctures, and that all the focal symptoms were limited to the right motor area, I suggested the only thing that could possibly offer relief was to explore and drain this area. This was accomplished by turning downward an osteoplastic flap over the motor area. A pool of pus was found subdurally over the motor centres. After the dura was opened, considerable evidence of intra-cranial pressure was noted, *i.e.,* the brain bulged through the opening. Two cigarette drains were introduced, the dura was left open, the flap replaced, and the scalp sutured. The patient died at the end of forty-eight hours. At the time of the operation another spinal puncture was made, and the fluid on culture showed pure *Streptococcus*

hæmolyticus. A culture taken from the surface of the dura also showed pure streptococcus of the hæmolytic type.

This is the second case coming under my observation within the last two months in which drainage was attempted for relief of symptoms denoting meningeal involvement where distinct and localized focal symptoms were present. The other case followed an automobile accident. The patient sustained a fracture which extended to the base of the brain and remained in a semi-conscious state with pulse at 50 and blood-pressure of 120 mm. Hg. for nearly a week. He then began to manifest signs of meningeal irritation, the symptoms apparently being Jacksonian in type, twitching of the right face and right arm. An operation similar to that just described was performed, the skull being opened and the involved area drained. The ultimate result was the same as in the case reported.

These two cases simply illustrate the result usually expected following injuries of this kind where infection occurs. Personally, I have seen only one patient who recovered from operation under similar circumstances. That was staphylococcic infection in a child who had distinct focal symptoms involving the face and arm. The motor area was exposed and drained and the child recovered.

Cases of this character present a very formidable aspect, and yet when encountered the only possibility of saving life is by the application of surgery, and the patient should be given the benefit of this chance. It is well known, however, that fatality ensues in the vast majority of instances.

I think we are prone to overlook the importance of slight increase in the blood-pressure, particularly in patients who have received injuries. In the case reported, the man had a blood-pressure of 150 mm. Hg. In cases of this kind one does not see the high blood-pressures which are noted, for instance, in arteriosclerosis. I recall an instance where this was overlooked not very long ago in the Louisville Public Hospital. The patient had a localized abscess of the brain which was not diagnosed clinically. His blood-pressure never rose over 5 mm. above what was considered normal. At the autopsy a large collection of pus was found. Particularly following brain injuries one should not rely too much on blood-pressure until shock has subsided, because shock tends to lower the blood-pressure which increases after shock has subsided. Such a phenomenon is not in-

frequently observed in concussion and compression of the cerebral tissues.

Oftentimes retinal changes do not develop early enough to be of much diagnostic importance. Following trauma to the brain, it is usually three or four days before papillo-œdema is present. Such changes as do occur are oftentimes overlooked, especially if examination is made by one unfamiliar with the importance of slight changes resulting from increased intra-cranial pressure. Engorgement with tortuosity of the veins is strongly suggestive where there is a history of intra-cranial injury or acute meningeal involvement. Choked disc, which is so common in chronic increased intra-cranial pressure, is not seen in acute cases.

REPORT OF A CASE OF ARGYRIA

By S. A. SAVITZ, M.D.,
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IT has long been known that the prolonged administration of any of the soluble salts of silver may result in chronic silver poisoning, commonly known as argyria. The use of silver locally will produce a slate-colored appearance, and is particularly demonstrable when used in the conjunctivæ and eyelids. Years ago general argyria was not an uncommon occurrence, due to the prevailing idea that silver was considered a curative agent for epilepsy and gastric ulcers. Silver nitrate in particular was used very extensively in all forms of chronic gastrointestinal disorders. The very first sign to be observed is a slate-colored line along the gums. Later, grayish patches appear on the skin, and spread over the entire body. These patches gradually acquire a slate-colored appearance.

The following case was admitted to the Service of Professor S. Solis Cohen, Philadelphia Hospital, April 10, 1919.

W. G., 56 years old; born in Ireland; laborer. He gave a history of " indigestion " for the past ten years. Five years ago he was treated in this hospital for a similar ailment and was entirely relieved. Since last June he complains of a constant pain in the gastric area. It is apparently not widely disseminated, comprising an area of about three inches, rectangular in shape, extending from the xyphoid to the umbilicus. It is a dull pain and continuous with acute exacerbations of a sharp and cutting quality. It bears no relation to meals or quality of food. He claims that at times he feels better on an empty stomach. He never vomits and seldom has a feeling of nausea. Dyspnœa follows the least exertion, and for that particular reason he has been confined to bed most of the time.

Family and past histories are negative. His present trouble dates back eight years. Since then he has been taking medicine from his family physician nearly all the time, except the space of time he has been confined to the Philadelphia Hospital, five years ago. About

one year ago his relatives called his attention to his discolored skin, and it was then that he discontinued the medicine.

Physical examinations revealed nothing unusual except tenderness in the gastric region. The X-ray report was negative. He was transferred to the surgical ward, where, on May 2, 1919, he was operated on with the following results. " Chronic appendicitis with many adhesions around the appendiceal region." The operation clearly showed the reason for his long-standing suffering. He made an uneventful recovery, but whether or not the slate-colored appearance will disappear from his skin is a question.

Argyria may be confounded with chronic acetanilide poisoning. Our conclusion that the medicine he had taken was some form of silver preparation is, after all, only a conjecture. The blood in this case was pratically normal, which in itself is a sufficient differentiation from chronic acetanilide poisoning, where we at least have a distinct leucocytosis and a marked reduction in the hæmoglobin. There were no other signs pointing to acentanilide poisoning excepting the abdominal tenderness, dyspnœa, and to a certain degree, prostration. The spleen was not enlarged.

Dr. R. C. Rosenberger was kind enough to take a specimen of the blood to the Chemical Laboratory of the Jefferson Medical College, where a spectroscopic examination was made which was negative for acetanilide poisoning. The diagnosis of argyria, therefore, seems to be very well sustained.

THE SYPHILITIC PHLEBITIDES

By MARCEL GAUJARD, M.D.

Châteauroux, France

As an introduction to the study of the venous luetic processes, I cannot do better than to report the two following cases:

CASE I.—Married woman, æt. fifty years, came to the out-patient department of the Cochin Hospital in March, 1913, on account of a painful swelling of the right upper limb.

Examination showed a hard, white œdema, extending from the hand up the forearm and arm. It did not pit on pressure. On the internal aspect of the arm, in the area of the vasculo-nervous bundle, an elongated tumefaction exists in the form of a very hard, doughy infiltration, which makes it impossible to dissociate the structures composing this bundle.

About January 20, 1913, the patient just felt a kind of lassitude in both arms following her work (she was a laundress), but more pronounced in the right member, along with a feeling of stiffness in the muscular mass of the anterior aspect of the arm.

On February 2, the arm commenced to swell quickly, while at the same time the painful phenomena in the area of the vasculo-nervous bundle became accentuated. The patient felt feverish, took her temperature and found that it was 39.6° C (103.4° F.), and this rise lasted, according to the patient, for four or five days.

On the same day (February 2) she consulted a physician, who made a diagnosis of abscess and ordered hot sublimate baths. The patient followed this treatment of one month and was relieved of the pain, but the swelling persisted. On March 8 she came to the Cochin Hospital.

Personal Antecedents.—Syphilis at the age of twenty; mucous patches of the anus and vagina. The diagnosis was made at the Broca Hospital, where she was given, at the time, a series of Hg. injections. Patient was obliged to return to the hospital a year later on account of a return of the mucous patches, and two more series of injections were given.

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At the age of thirty-six, she suffered from pain in several joints; these finally subsided and only the knee remained painful. These joint manifestations did not oblige the patient to go to bed, neither was there a rise in temperature. For ten months she was regularly treated at the Salpêtrière, receiving electrical treatment of the lower limbs.

At the age of thirty-seven she had an inflammatory process in the right lung, and following this the patient coughed for four or five years, but never expectorated blood. Ten years later, she had another right-sided pulmonary congestion.

On March 8, a series of intra-muscular injections of Hg. iodid. rub. at the dose of 1 centigram every second day and potassium iodide by mouth at the daily dose of 3 grammes.

March 15. The patient had received four Hg. injections and already the œdema of the arm had considerably diminished, especially over the internal aspect of the arm, and instead of the hard, diffuse tumefaction, one could easily palpate isolated cords and to follow them down to the fold of the elbow.

March 22. Amelioration still more accentuated. The œdema of the hand and forearm have practically disappeared; the tumefaction of the internal aspect of the arm had diminished considerably; there is yet quite marked œdema of the posterior aspect of the forearm. The Hg. injections were continued every second day and potassium iodide by mouth was also continued.

April 5. The patient had been given massage and passive motions. Movements of the elbow were then possible. Improvement persists, the œdema had nearly disappeared; Hg. injections stopped.

April 21. The patient now only complained of some occasional insignificant pain; a slight induration over a small area could still be detected on the internal aspect of the arm; the joint movements were perfectly free and painless. The Hg. injections were again given.

May 17. The patient returned after the second injection of the second series. She had no pain and all lesions of the right arm had completely disappeared. Massage was, however, continued.

CASE II.—Male, æt. thirty-six years, clerk, was seen for the first time on November 21, 1908, on account of a very œdematous right arm. The affection had commenced on October 20, and for a few days previously the patient had experienced some heaviness in the

right upper limb, when on awakening this morning he noticed a considerable swelling of the entire limb. A physician was consulted, and in a note made at the time the doctor states that the right arm was very œdematous and considerably increased in size. Comparative measurements of the two arms showed that the circumference of the involved limb over the middle of the biceps was 10 centimetres greater than on the left.

The hand was violet colored, and on the skin of the arm were a few scattered reddish spots, and the doctor's notes say: " The superficial veins, or, rather, the superficial venous network, had become turgescent, indicating an evident occlusion of the circulation." The patient did not suffer and only complained of some stiffness in the limb, which was absolutely impotent and could not be moved excepting by the other hand. This condition remained stationary for eight or ten days, after which a progressive retrogression of the œdema and swelling took place.

When first seen (November 21) the affected arm was slightly flexed and held on the lap. The patient could dress himself and presented a very œdematous right upper limb. The back of the hand and forearm were somewhat swollen, but the tumefaction was much more considerable over the arm, and especially at the stump of the shoulder. The limb was a perfect type of the " *leg of mutton* " arm. A certain degree of œdema was also noted in the region of the scapula, under the axilla and over the most external portions of the anterior thoracic wall.

The integuments were white and smooth. The œdema was resistent to finger pressure and did not pit. Pressure was not painful and passive movements transmitted to the arm and shoulder were completely painless.

The local temperature of the right upper limb was normal, and, compared with that of the left, was the same. The pulse was well sustained and appeared to be quite as strong as on the left. However, the blood-pressure taken with a Potain apparatus was less on the right, it being 14, while the left gave 17.

The various functions were normal. Digestive tract negative. There was a slight degree of pulmonary emphysema, and over the aortic area the diastolic sound was rather sharp. Urine free from albumin and sugar.

The œdema of the arm slowly decreased. However, a week after our first visit, the swelling of the hand and forearm had already completely disappeared, only the tumefaction of the arm and shoulder remaining.

Careful measurements now made showed that the upper part of the right upper limb was three and one centimetres larger in circumference than the left. While the circumference of the lower segments of the arm was still two to three centimetres more on the affected side, the right forearm and wrist were not more than one-half centimetre larger in circumference than the left, a difference which is practically physiological, since it is in favor of the right upper extremity.

The patient was discharged on December 7. He thought himself well. The root of the right arm was still slightly œdematous, as well as the axillary region. The hand was perfectly normal, all movements being possible.

Now, here is a thirty-six-year-old male, strong and without any infirmity. Both his father and mother are in good health. The patient's wife is well, has never miscarried, and there is one healthy living child. Patient has two living sisters, one being afflicted with mental disease.

As to the patient himself, he had smallpox at the age of five years. When doing his military service he had some paroxysms of malaria, while at the age of thirty he had some pulmonary affection, to which he attributes the emphysema.

Seven years ago the patient had a syphilitic chancre followed by characteristic secondary manifestations. The syphilis was only moderately treated. First year, protiodide pills; second year, Syr. Gibert; third year, potassium iodide, and the fourth year he had no treatment, but instead got married.

We treated this patient with Hg. injections almost as soon as his phlebitic accidents developed (his physician knew him to be syphilitic and believed the affection to be an arteritis). From the time we first saw him a rigorously applied treatment with intra-muscular injections of Hg. iodid. rub. at the dose of two centigrammes. Amelioration was progressive and rapid. He was discharged at the end of fifty days from the onset of the symptoms, and after a fortnight's treatment the patient might be considered cured.

Early Syphilitic Phlebitis.—This early venous manifestation is a lesion not well known and is unquestionably more frequent than is generally supposed. As it gives rise to no alarming symptom, it may very well pass by unnoticed, and undoubtedly not a few cases are overlooked.

This form of syphilitic phlebitis occurs early in the infection; it has been met with a few days after the appearance of the primary sore, before any secondary lesion is present. Usually, however, its onset is during the full secondary eruption, at the time when infection appears to be the most generalized; that is to say, during the first three months following the chancre. This lesion rarely occurs as late as the seventh or tenth month of the secondary phase.

The age of the subject does not appear to have any bearing on the lesion, but from published cases it would appear to be less common in the female than in the male. The latter is more exposed to hard work and prolonged standing position, which are factors in the localization of the luetic virus in the veins. There is reason, however, to make some reservations in this respect, because in a large number of cases the patient did not indulge in hard work, and several of them even remained in bed when the phlebitis developed.

The presence of varicose veins does not appear to favor the development of syphilitic phlebitis, but alcoholism, more common in the male, may, perchance, play a secondary part in the production of this lesion. In the majority of the recorded cases the syphilis was of the ordinary type, the specific manifestations offered nothing special, but in some instances there appeared to be a tendency to a multiplicity of visceral lesions.

The onset of early syphilitic phlebitis is often quiet. A phlebitis develops, but gives rise to no spontaneous pain, and for this reason it is probable that the lesion escapes notice in a large number of cases of early syphilis. It is only by exploration, systematically carried out, of the superficial veins that a painful sensation may be elicited along the venous trunks. Sometimes, however, the patient's attention will be awakened by a feeling of stiffness or pain in the limb involved, with nocturnal muscular cramps and tingling, which the attending physician has wrongly attributed to secondary peripheral algesis, so common in syphilis.

The phlebitis is usually seated in one of the superficial veins of

the limbs, internal saphenous, for example, and this is the clinical type I shall select for the clearness of description. By inspection, the limb will be found in normal position and size; occasionally a slight rosy lymphangitic streak following the course of the vein and one or two centimetres in breadth will be seen. This is a most inconstant phenomenon, and simple inspection reveals no symptom, the superficial collateral circulation being ordinarily absent.

By light palpation, a hard, irregular or moniliform venous cord can be felt, varying in size from a goose's quill to that of a pencil, and extending along the entire tract of the vein or only on a portion of it, without any adhesion to the skin, muscles or aponeurosis. Fournier long since pointed out that the lesion in the vein might be limited to a small portion of the vessel or involve a long segment corresponding to a segment of the limb, or more frequently the entire venous trunk, from its starting point to end, is involved.

Roussy has proposed calling the first variety *partial syphilitic phlebitis,* the second *segmentary phlebitis,* and the third *total phlebitis.* Finally, in cases where it is moniliform, presenting indurated segments, separated by normal parts, he calls it *fragmented phlebitis.*

Occasionally a slight increase of the local temperature is noted; in certain cases a slight and quickly vanishing œdema localized to the malleolæ and posterior aspect of the legs occurs, which can be detected by palpation.

The functional symptoms of early syphilitic phlebitis are usually discrete and the patient may experience nothing more than some stiffness in moving, but not to the extent of preventing walking. In other instances, pressure over the area of the thrombosed vein will only give rise to localized pain, and it is indeed infrequent to meet with a case where the pain attains the degree encountered in ordinary cases of phlebitis. In some exceptional cases the pain may offer nocturnal exacerbations. Objective nervous phenomena or trophic muscular or joint disturbances do not occur as in ordinary phlebitides.

The general symptoms of early syphilitic phlebitis are likewise mild. A slight rise of temperature may occur for one or two days, but never the usual train of serious general symptoms met with in the infectious phlebitides.

The evolution of early syphilitic phlebitis is probably the most characteristic of this lesion. It begins suddenly with a low inflamma-

tory modality, and then very rapidly becomes a quiescent process in the form of a plastic induration of the vessel walls. The evolution is slow and lasts for four to six weeks, as in the case of infectious phlebitides in general. Recovery is the rule, and the process leaves no trace behind.

What causes the gravity of phlebitis in general are the serious complications, such as embolus, which rarely, if ever, disturbs the quiet evolution of the luetic variety. I only am aware of a single case of embolus in the syphilitic form. This was reported by Jullien, and it ran a benign course. This is a truly remarkable fact, and is sufficient to individualize the process under consideration. The prognosis is consequently excellent and the effect of antisyphilitic treatment certain.

Recurrences of syphilitic phlebitis have been observed a number of times, and may be regarded as rather frequent. In recurrences, the lesion may involve other veins successively, but these recurrences do not appear to have a greater gravity, and give way to treatment easily. This marked tendency to recurrence is still another peculiarity of early luetic phlebitis.

This morbid process assumes certain clinical forms, which vary with the location and number of veins involved. Usually the process is seated in the superficial veins of the limbs, and this form is the commonest and best known.

Its site is the internal saphenous vein or the veins of the upper limbs, and when occurring in the latter the symptoms are probably more discrete, the cephalic vein being usually completely involved. Œdema is often absent, pain is trifling and often *nil,* and it is by mere chance that the presence of a thrombosed vein is found on the arm. Finally, in other cases some slight functional impotence will draw attention to the lesion.

Phlebitis of the deep veins is much more rare, but cases do occur from time to time, assuming the clinical aspect of *phlegmatia alba dolens.* Both the deep veins of the lower or upper limb may be affected.

It is uncommon for this early form to become localized to a single vein; usually several veins of a limb are involved, and sometimes the veins of several limbs are affected. The multiplicity of involved vessels is quite special to syphilis, and is hardly, if ever, seen in diseases susceptible of provoking phlebitis. Usually the lesions are bilat-

eral and occur at symmetrical points. The different veins are simultaneously involved, or at least at short intervals from each other, but cases of syphilitic phlebitis occurring in successive outbursts have been met with.

The histologic pathology is at present known, as several examinations from biopsied thrombosed veins have been made, which show that this form of phlebitis offers nothing characteristic.

In the specimen examined by Thibierge and Ravaut, the lumen of the vein was occluded by a clot which, at certain spots, appeared to be distinctly separated from the endothelium by small clear spaces, and which, over the greater extent of its base of insertion, appeared to be solidly fixed to the internal tunic. The clot gave the impression of being already old.

The endothelial layer was normal, no change being found anywhere; the subendothelial stratum had proliferated into the lumen of the vessel in the form of projecting conical, cylindroid or irregular shaped buds. These buds were of different heights and could be grossly compared to villous outgrowths projecting into the lumen of the intestine. Thus, on cross section, the lumen of the vessel had a stellate shaped aspect.

The buds were covered on their surface by normal endothelium, and had as a base the limiting elastic internal membrane, almost regularly circular and in no way dilacerated. It did not follow the sinuous outline of the buds. The latter were formed essentially by a dense fibroid connective-tissue, having somewhat the aspect of mucous tissue, throughout which involuntary muscular fibres were scattered and united in tiny bundles running parallel with the axis of the vessel.

There were no vessels or elastic fibres in the buds. The subendothelial stratum was, therefore, infiltrated with connective-tissue and distinctly thickened.

The external tunic offered normal connective-tissue, plated with fat cells and very vascularized; the vasa vasorum were gapping and were not surrounded by perivascular lymphatic islands. The vessels penetrated into the middle stratum, but did not reach the muscular fibres of the subendothelial stratum. It should be added that the muscular tunic did not offer any appreciable change; there were a few mononuclears in the interstitial spaces.

From this examination, as well as the results recorded by others,

it happens that the venous lesions are characterized essentially by an infiltration of connective-tissue in the subendothelial stratum of the vein, giving rise to buds projecting into the lumen, thus reducing its calibre and giving it a stellate aspect.

The presence of a clot in the vessel is inconstant; when one does exist, it is solidly united to the internal tunic, which explains why embolus is very infrequent during a syphilitic phlebitis. Implication of the mucous stratum and external tunic is frequent.

All these histologic researches are unquestionably of great interest, but they do not demonstrate the syphilitic nature of the phlebitis. It had been supposed that syphilitic phlebitis was governed by the same pathogenesis as other forms of infectious phlebitis, and that it had a microbic origin, as Widal and Vaquez had shown in the case of the latter. It was, however, only by detecting the presence of the treponema in the wall of the vein that the specific nature of the process could be proved, and this was done by Thibierge and Ravaut. Therefore, I cannot do better than to quote this part of their paper:

On March 6, they removed a piece of the right internal saphenous vein, measuring 5 centimetres in length, between two ligatures.

On section of the excised vein the lumen was found almost completely occluded and hardly any trace of it could be seen. The vein was cut with all due aseptic precautions in the direction of its long axis, and showed that it did not contain either clots or fluid blood, but only a small amount of serous fluid.

Scrapings taken from the internal tunic of the vein were examined with the ultra-microscope and five spirochætæ were seen in the midst of the cell detritus. The organism had all the characteristics of the pallida, but only two of them were endowed with movements. No other bacteria, spirillæ or spiral filaments were encountered.

Three other scrapings were taken with the same precautions, and were stained with largin, but only two very distinct spirochætæ could be found in the microscopic fields.

As soon as the vein had been excised, a macacus rhesus was inoculated at two separate spots—which had been previously scarified—the right orbital region and the free border of the right upper lid, with the serous fluid obtained from the lumen of the vessel, and by direct friction with small bits of the vein.

On April 1, the twenty-fourth day following inoculation, a ham-

colored macula, 5 by 3 millimetres in size, appeared on the orbital point; the macula was slightly raised from infiltration of the integuments. No lesion was visible on the eyelid. On the following day the orbital lesion became more distinct, while on the free border of the upper lid, where the scarifications had been made, a dark-red œdema appeared.

On April 3, 4 and 5 the lesions became more evident. On April 6, the lesion on the orbital area diminished in intensity and became the seat of a slight desquamation. The lesion on the free border of the lid was also less distinct.

On April 8, the lesions were yet more attenuated, but were still quite distinct, especially that on the border of the lid. These lesions were those of experimental syphilis in the monkey, and could not be mistaken for anything else.

Nodular thrombo-phlebitis or *syphilitic erythema nodosum* should also be included among early syphilitic phlebitis. For a long time this lesion was regarded as an intermediary phase between secondary accidents and gumma, or as an affection of the subcutaneous connective-tissue. But the researches of the French and German schools, with histologic examinations to back them up, have thrown much light on this early syphilitic venous manifestation.

Nodular thrombo-phlebitis occurs during the phase of the secondary accidents. Its *onset* is usually silent, rarely giving rise to some slight painful phenomena, a little functional impotence, which might attract attention. It is often only after careful palpation that small nodes are detected on the limbs.

The nodosities are oval or round; in size they vary from that of a grape-seed to a pea, but they never reach the volume of a cherry-stone. They are firm, even hard, and their contours are well defined. They are not surrounded by œdema. They can be freely moved over the underlying aponeurosis, while the overlying skin can be picked up with the fingers. There is no change in the surface color of the integuments over them. Some few cases have been reported where there was a tendency for the nodules to become adherent. The nodules may be present in fairly large numbers. They are to be found scattered over the limbs, but they avoid the roots and extremities of limbs. It would appear that they are more common on the thighs and legs.

There is no œdema or ectasis of the vessels above them, while the

functional and general disturbances to which they give rise are really trifling. A little sensitiveness may be elicited by palpation, but no real pain.

Under the influence of antisyphilitic treatment, the evolution of the process is rapid, or at least relatively so, since it lasts from one to two months. However, the process may persist for a very long time in the form of a very slight induration, and Jullien has pointed out that when untreated, the condition may last for years, with a tendency to recurrences. These successive outbreaks are accompanied by a slight rise in temperature and considerable soreness over the site of the lesions, but this is rare.

Histological researches have shown that the process is a phlebitis of the hypodermic veins, the lesions possessing special characters, as is made evident by the description given by Darrier and Civatte, to which I shall now refer.

The tumor excised was the size of a pea and was enveloped by special fibrous coverings. Oval in shape, it was connected to the surrounding tissues by a cord which, when cut, presented the appearance of a central lumen. Microscopically this cord proved to be a vein.

Sections showed that the obliterating endophlebitis was an accessory phenomenon, and that a true neoplasia occluded the lumen and infiltrated the walls of the vessel. It had destroyed the muscular tunic, became substituted for it, and at certain spots it came into direct contact with the adventitia. At other points it only dissociated the muscular fibres, pushing them before it. The endothelial membrane resisted.

Examination of the neoformed tissue showed that syphilis was at the bottom of the trouble. At a certain point of a section this was seen to be made up of plasmazellen lying upon and grouped around the dilated capillaries, whose walls were somewhat thickened, realizing the histologic picture of secondary syphilitic infiltration.

In many parts of the field the sections showed that they were composed only of vascular connective-tissue with some giant cells, recalling a vulgar endophlebitis, a fact which may be explained by a retrogression of the lesions following an antisyphilitic treatment that the patient had taken. These lesions were enough for a diagnosis of syphiloma to be made.

Darrier and Civatte conclude by saying that this syphiloma, aris-

ing in the wall of the vein, occluded the lumen and narrowed the calibre of the vessel, giving rise secondarily to thrombus formation. The endophlebitis was of the usual benign type, and the periphlebitis was the principal phenomenon. The important fact is that this was a secondary syphilitic manifestation.

I shall now endeavor to describe the principal characters of *late syphilitic phlebitis,* from my personal cases and those of others. This lesion appears in subjects who have contracted syphilis a number of years previously, being seven and twenty, respectively, in my two cases, and thirty-four years in one reported by Roques.

Sex, profession or general state of health seem to have little or nothing to do with its occurrence. Alcohol, trauma or overwork have been incriminated, but in speaking of early secondary phlebitis I referred to the necessary reserve which should be taken concerning these various supposed causal factors. The syphilis itself is quite enough to explain these phlebitic manifestations.

The deep veins are those most commonly involved—the humeral vein in one of my cases, the popliteal and posterior tibial in Roques' case. It is frequently this way in syphilis, the late lesions are regional and deep-seated, while the early lesions are less marked and diffuse. And still more, there is not usually that multiplicity of the veins involved as is the case in early phlebitis.

The onset of the late variety of phlebitis is usually announced by pain in the involved limb. At the same time the patient feels some stiffness or weight in the member, and soon after this functional impotence becomes established and the limb increases in size. It is then that the patient's attention is aroused and a physician consulted.

A slight febrile reaction is quite common, and it may even be quite marked, the temperature reaching 39° C. (102° F.) or even more.

This train of functional and general symptoms is constant in late luetic phlebitis, and this onset is to be compared with that of the early form, where it is usually quiet.

Examination of the limb strikes one on account of the excessive œdema, and as much as 10 centimetres difference between the circumference of the two limbs has been noted. The deformity of the limb will depend upon the distribution of the œdema, which is generalized in some cases, in others it is more marked at the root of the limb,

while in some instances it follows the involved vein. It is a *white œdema,* streaked by a venous network due to turgescence of the superficial veins.

Palpation will reveal its hardness, but it does not pit on pressure. When the œdema and distribution of the vein allow, an elongated tumefaction or a very hard doughiness, corresponding to the vasculo-nervous bundle, can be made out, all being plunged in a mass of œdema. The component elements cannot be made out one from the other.

In general, the tumefaction extends over a very large portion of the venous segment, and it must be remembered that the entire venous trunk may be involved.

The functional symptoms of the onset increase and real pain takes the place of the early stiffness. The pain is spontaneous and is increased by palpation, while nocturnal exacerbations are not uncommon. Impotence is marked. No changes of the sensibility nor articular or joint disturbances are noted.

The general symptoms are not very accentuated; the rise of temperature at the onset may continue for several days, but this is about all.

The evolution of the process is rather slow, but under antisyphilitic treatment the œdema slowly subsides and the doughiness over the venous trunk tends towards resolution. Then the venous cord can be felt and the collateral circulation disappears. At the end of six to eight weeks the process will have retrogressed completely.

In the cases so far published, complications are not mentioned during the evolution of the process; neither is there any mention of successive attacks involving different veins. Relapses have not been observed. Emboli have not been noted, although the patients were not kept at rest, so that the absence of this complication must be regarded as characteristic of venous syphilis.

The pathologic histology of late syphilic phlebitis has been fully studied by Roque *à propos* of a case of painful intermittent cyanosis of the great toe in a male, æt. fifty-four years, who had contracted syphilis at the age of twenty. The affection evoluted to gangrene and amputation of the thigh at the middle third was necessitated. The femoral artery was occluded by a thrombus, likewise all the arteries of the leg; the vasculo-nervous bundle was converted into a kind of compact, hard tractus, in which the vessels could not be dissociated.

Sections made from this tractus showed microscopically that the popliteal vein and the tibial veins had, like the arteries, undergone an inflammatory process.

A transversal section of the popliteal vein offered an irregular lumen, quite distinctly stellate, with four branches. The lumen was completely occluded by a clot undergoing organization. The walls of the vein were generally thickened, but irregularly so. The occluding clot, yellow-brown in color, appeared to adhere intimately with the lumen of the vessel.

No endothelial covering can be found on the endovein. On the middle portion of the internal circumference of the vessel, the internal tunic no longer exists with its anatomical characters; it is replaced by a tissue of about equal thickness everywhere.

This tissue contains small cells, some round, others elongated or fusiform, separated from each other by an intercellular substance of fibrillary appearance and giving the reaction of connective-tissue. At one spot, the internal tunic of the vein forms a considerable thickening, so that it projects into the lumen of the vessel. In this thickened tissue round and fusiform cells and stellate elements are found. These cells are separated from each other by a large amount of intercellular fibrillary substance.

The internal tunic is distinctly separated from the other tunics of the vein by an elastic tissue stratum beautifully undulated, and outside this elastic tissue stratum the other tunics appear to be blended together and offer an analogous look. These tunics are made up of very abundant dense connective-tissue, and contain a large number of various shaped cells. At several spots in the external tunic of the vein the elastic tissue elements show a marked rarefication.

The middle and external tunics offer very marked variations in thickness at different points, but nowhere could any giant cells be seen. In the adventitia, all the vas vasorum are thickened.

The microscopical examination of sections of the posterior tibial at the junction of the middle with lower third of the vessel gave quite similar findings. To sum up, what is particularly manifest in the venous lesions is a connective-tissue infiltration involving all the tunics, but especially the internal. The clot was everywhere very adherent to the internal surface of the vein.

These characters are similar to those met with in early syphilitic

phlebitis, and the demonstration of the treponema in the midst of the tunics is the pathologic characteristic of the affection. From what has been said, it results that the late phlebitic manifestations are similar to the secondary phlebitis as far as their histologic features are concerned, but their clinical aspects and time of appearance place them in a class by themselves. They are distinctly different, from the viewpoint of pathology, from the tertiary forms of phlebitis described in the classic text-books, and in order to complete the subject of pathology, I will briefly refer to the latter process.

Tertiary phlebitis may involve either the deep or superficial veins of the limbs. When seated in the superficial vessels the lesion appears as a hard lump, little inclined to inflammatory reaction, rather oblong in shape and following the course of the vein. The skin over the lesion shows no change.

The functional symptoms consist of a slight and rather disagreeable feeling when pressure is applied to the part, and in some cases there is spontaneous pain and relative difficulty in moving the limb. The evolution of the lesion is very slow; the tumor increases in size and its consistency varies with the pathologic changes as they arise.

In the deep veins of the limbs and neck the process sets up rather severe pain at the site of the lesion, and combined with œdema, an absolute functional incapacity ensues. A diffuse doughiness can be felt, which gives the impression of a tumor adherent to the underlying deep structures. Œdema and a collateral circulation often complete the clinical picture.

These symptoms have no tendency to spontaneous retrogression, and the common complications of phlebitis—embolus and infection—have been observed.

Pathologically, tertiary phlebitis is characterized by the development of a circumscribed neoplasia, or more rarely, a slow, diffuse, inflammatory process, ending in a more or less extensive sclerosis. These two processes have been called gummatous syphilitic phlebitis and sclerous syphilitic phlebitis.

The gumma develops on any vein, superficial or deep, but only rarely are several vessels involved at the same time. It is an isolated lesion and always starts in the adventitia. It appears as a tumefaction the size of a hazelnut and may attain that of a goose's egg. When the lesion is elongated and oval, it follows the long axis of the vessel, but

the round gumma adheres to the surrounding structures. The consistency varies with the length of time the lesion has been present—renitent at the onset, hard at an advanced stage. Usually the vein is surrounded by the gumma. The lumen of the vessel may be reduced but patent, or it is occluded by an adherent thrombus.

Histologically, the inflammatory process offers at the onset numerous embryonal cells and plasmazellen collected together in the external tunic. Sometimes the inflammatory process is diffuse and extended, uniformally invading the periphery of the vein; at others—and this is the most usual—it has a tendency to form miliary nodules, which surround a giant cell. These nodules project outwardly and attain considerable size, forming true gummata, which follow the classic evolution.

The process may invade all the tunics, and by its progressive infiltration reduces or even occludes the lumen of the vessel. Therefore, periphlebitis is the initial phenomenon of the process, and a vulgar endophlebitis may secondarily ensue from contiguity.

Sclerous phlebitis has a particular liking for the visceral veins and rarely attacks those of the limbs. It consists of thick, calcified plaques scattered along the vessel. Microscopically, the involved structures show a cell and neovascular proliferation of the fundamental connective-tissue of the venous structures, dilatation of the vasa vasorum and a mammillated tumefaction of the internal tunic. But whether the case be one of sclerosis or a gumma, the initial and essential lesion is a periphlebitis, the endophlebitis usually being secondary, inconstant and of little importance.

To make the diagnosis of an early luetic phlebitis, a careful, methodical examination of the limbs, during the primary and secondary stages of syphilis, must be made. I have sufficiently insisted upon the quiet onset of the process and need not again refer to it. If a patient with cutaneous or mucous manifestations of syphilis presents an indurated cord along the course of a superficial vein of a limb, the diagnosis of early syphilitic phlebitis is relatively easy.

Causes of mistakes are possible, especially when the secondary accidents are not yet pronounced or so attenuated as to be overlooked at the first examination. The torpid form of the disease, which does not give rise to a febrile reaction, and undergoes its evolution in six weeks to two months without complications and with a marked ten-

dency to diffusion, relapses and spontaneous resolution, should contribute to enlighten the diagnosis.

It is a more delicate and difficult matter to differentiate between a phlebitis and a syphilitic lymphangitis, which also forms a hard cord, more or less superficial and elongated, sometimes painful, and accompanied by red cutaneous streaks. It is very probable that cases of phlebits have been diagnosed as lymphangitis.

Fournier has pointed out that a lymphangitis is represented by a hard cord starting and ending in a group of lymph-nodes, these latter being tumefied. This cord does not exactly follow an anatomical course of a vein, and at a little distance from it the blue line of the subcutaneous vein can be seen. The cord formed by a lymphangitis is usually less painful on palpation than an inflammed vein. Pressure made at the root of the limb over a vein produces an even turgescence of all the superficial veins of the limb, while in phlebitis the point at which the occlusion of the vessel has occurred can be distinctly seen, because from this point distally, the venous affluents do not bulge. This is " Fournier's compression sign."

But as Jullien has pointed out, regardless of the evidence offered by these signs, it is nevertheless a fact that mistakes have been frequently made, and it is probably for this reason that more cases of early syphilitic phlebitis have not been reported in the past.

The diagnosis is made in entirely different conditions when, as often happens, especially in late phlebitis, the patient first consults the physician when the limb is the seat of a white œdema with a collateral circulation. At first sight the diagnosis of diffuse phlegmon might be made, but the redness, vesicles, swelling *en masse* of the entire region, impart an entirely different look to the limb. Then, again, palpation does not reveal any deep-seated doughiness localized along the course of a vein, and the general phenomena are much more marked in phlegmon.

In other instances the diagnosis of arteritis was at first made. The absence of pulsation along the course of the vessels, coldness of the limb and tendency to gangrene should not allow one to mistake this process for a phlebitis. But in one case, that reported by Etienne and Lucien, the two processes coexisted; there was an obliterating syphilitic arteritis and phlebitis of the popliteal vessels. The arteritis

had been diagnosticated, but the phlebitis was only discovered when the microscopical examination was made.

When a diagnosis of phlebitis has been made, it then remains to decide its nature. I do not think that it is necessary to refer to the phlebitides resulting from infectious or cachetic processes (tuberculosis, cancer), but two types of phlebitis are worthy of our attention; I refer to *gouty* and *rheumatic* phlebitis, because they are far more likely to give rise to mistaken conclusions.

Gouty phlebitis has a sudden onset, with very sharp pain and nocturnal exacerbations. It is usually seated on the superficial veins of the lower limb and is more often symmetrical than not. It is mobile, occurs in attacks and disappears from one point to appear at another. The integuments covering the lesion in evolution are red or violet, and the indurated vein is exquisitely sensitive. The process usually occurs at the end of acute paroxysms of gout, and it has been known to give rise to pulmonary embolus.

Rheumatic phlebitis, a rare affection, can give rise to much difficulty in diagnosis, because frequently the local manifestations are identical, but the phlebitic attack in rheumatism is accompanied by a recrudescence of the febrile and painful phenomena of the general disease. But if the febrile polyarthritis, endopericarditis or pleurisy are absent and the patient is a syphilitic, the diagnosis of rheumatic phlebitis should not be made, because the venous process will be luetic in all likelihood.

After having gone into all the possible causes of venous compression or inflammation, and when these can be eliminated, the diagnosis of a syphilitic process alone remains. The physician should look for the cutaneous and osseous stigmata of the disease; likewise cicatrices left from healed gummata or other specific lesions. A positive Wassermann will settle the question, or if negative, the happy influence of treatment on the phlebitis will indicate its specific nature.

I will now examine the differential diagnosis of nodules arising in the hypodermic veins which are characteristic of nodular thrombophlebitis. It may, for example, be a question of erythema nodosum, in which case the topography of the elements, the trifling pain to which they give rise, the perfect mobility, the absence of any adhesion with the integuments and the presence of erythematous congestion will leave no doubt as to the disease. The very independence of the

nodular lesions in relation to the skin and deep structures eliminates the diagnosis of syphilitic gumma.

Nodular lymphangitis gives rise to redness of the integument and swelling of the lymph-nodes, both of which are never present in thrombo-phlebitis.

Syphilitic myositis, with its small, hard, elongated nodules, might occasionally be mistaken for erythema nodosum, but if the patient be requested to make some active movements, it will be at once seen that the nodules move with the muscular contraction and become displaced. Histological examination, when possible, will show the luetic nature of the lesions.

In syphilitic gumma of the veins, the characters of the lesion are those of a real tumor, adherent and circumscribed, without inflammatory phenomena, but I mention this lesion because the diagnosis of carcinoma was made in a case by no lesser surgeon than Langenbeck. Operation showed that the tumor was adherent to the vein and microscopically proved to be a syphilitic production. One or two similar instances have been published.

The treatment of syphilitic phlebitis is at the same time symptomatic and causal. The patient should be put to bed, which will greatly hasten recovery. The limb should be done up in cotton, but unless the œdema is very considerable it need not be immobilized. Immobilization when required must be maintained until the pain, œdema and venous induration have all subsided.

When pain is severe, local applications of belladonna ointment or compresses moistened with a solution of hydrochlorate of ammonium are of use. When the acute symptoms have completely subsided prudent massage is indicated.

As soon as the syphilitic nature of the lesion has been diagnosed, an intensive treatment should be resorted to. Inunctions, intravenous injections of the soluble salts of mercury should be given, but the new arsenic preparations have so far not proved themselves to be of any particular value in venous syphilis.

In late syphilis of the veins, potassium iodide should, as a matter of course, be combined with the exhibition of mercury, in the dose of from 2 to 4 grammes daily.

THYMOGENOUS DYSPNŒA AND THYMECTOMY, WITH A REPORT OF SIX CASES

FROM THE SURGICAL CLINIC OF PROF. E. KUMMER, GENEVA

By PIERRE BOYADJEFF, M.D.

THE first thymectomy done for hypertrophy of the thymus gland appears to be due to Rehn, in 1896; then the operation was resorted to in 1897 by König; in 1899, by Perrucker; in 1905, by Ehrhard, and by Jackson in 1907. In this same year (1907) Marfau drew attention of the profession to the importance of this gland in infantile pathogenesis, and later Barbier and Méry carefully studied the subject and came to most interesting conclusions. Following the example of some English and German physicians, Veau performed the first three thymectomies in France, in 1909, which brought the total number of cases of removal of the thymus at that date to seventeen.

In the same year, Moizard published a paper in which he pointed out the danger arising in hypertrophy of the thymus and gave some indications as to the surgical methods to be resorted to. Olivier, who, as Veau's collaborator, had the opportunity of observing closely the first essays of thymectomy in France, published an important thesis on the subject in 1911. The literature of the subject of recent years will be found in Biedl's work on the internal secretions published in 1913.

The first five cases of thymectomy which I shall now report are due to the kindness of Professor Kummer, the sixth to Doctor Chassot, of Geneva.

CASE I.—Female, æt. two months, was first seen by Doctor Boissonnas, who made a diagnosis of tracheostenosis from compression of the thymus, and referred the patient to Professor Kummer for thymectomy. The parents were healthy, the infant was well developed at birth and developed normally during the first weeks of life. At the age of five weeks the parents noticed that the baby breathed noisily and with difficulty in the night and from this time on the infant began to eat less and vomited occasionally. For the three days previous to

first seeing the baby the respiration had become progressively more difficult and vomiting was frequent.

Status (Doctor Boissonnas).—A normally developed infant, extremely pale, pulse 140. Temperature, 99° F.; weight, 4 kilogrammes, 750 grammes. Dyspnœa, cyanosis of lips, inspiratory stridor, expiration free. When the child cried a hoarse cough developed, quite similar to pseudo-croup.. There was retraction of the epigastrium and the supra-sternal fossa at the time of inspiration; on the contrary, during exploration, there was a slight protrusion above the sternal fossa quite visible and evident to touch. In the sitting position, with the head slightly bent forward, the stridor was decreased and could be increased by extending the head. The voice was strong, without hoarseness; the respiratory tract, lungs and heart were in every way normal.

By palpation the epiglottis was found normal, while over the sternal manubrium abnormal dulness could be made out, extending beyond both edges of the sternum.

Diagnosis.—Tracheostenosis from hypertrophy of the thymus. Obstruction of the respiratory tract was made evident by the retraction of the epigastrium at the time of inspiration. The seat of this obstruction was neither in the pharynx nor larynx, these having been shown to be intact by direct examination, the resistance met with in the supra-sternal fossa and the abnormal dulness over the sternal manubrium could be explained by the presence of an hypertrophied thymus.

Operation (April 28, 1910).—Median, vertical incision, about four to five centimetres long. Exposure of the middle rhaphe, which was incised; retraction of the sterno-hyo and sterno-thyroid muscles; thyroid gland normal. Underneath it and behind its capsule the upper portion of the thymus could be seen rising and descending. Median incision of the thin fibrous capsule of the thymus. This gland, when once exposed, presented its lobulated aspect and characteristic whitish color. With Kocher's hæmostats both lobes were drawn up into the wound after ligature of a few vessels which went from the capsule to the parenchyma. The left lobe was notably larger than the right. They were ligated together *en masse* near their upper poles, and both were removed almost completely. It is, however, probable that some lobules of the thymus were left behind in the mediastinum. Once the

thymus had been brought out of the wound a flattening from in front backwards was noted; the trachea also appeared to be a little softened. As soon as the thymus had been removed, breathing became easier. A small glass drain was inserted and the muscles and skin sutured. Dry, sterile dressings.

Pathology.—The weight of the removed gland was 30 grammes; length of the left lobe, 10 centimetres; length of right lobe, 7 centimetres; breadth of both lobes taken together, 4 centimetres; thickness, 2½ centimetres.

Histological examination by Professor Askanazy showed that there was a simple hypertrophy of the thymus with hemorrhage into the right lobe.

On the day following the operation some subcutaneous emphysema developed around the wound, and it was found that the glass drain had produced a small wound in the trachea. Simple packing of the wound was first tried, but as this was found to be insufficient a tracheotomy was done. Right pulmonary congestion. The tracheotomy cannula was removed sixteen days later; a second attack of pulmonary congestion resulted in death three weeks after the operation.

Case II.—Male, æt. two months. Diagnosis of thymogenous tracheostenosis made by Doctor Boissonnas and child referred to Professor Kummer's clinic for operation. Both parents are well; an older brother died of peritonitis at the age of two weeks.

Personal Antecedents.—From the day of birth the infant presented paroxysms of suffocation, with cyanosis of the face and limbs; the paroxysms occurred daily, sometimes several times a day, and usually lasted several minutes. During the interval of the attacks, the child was playful and appeared to be perfectly well.

Status (Doctor Boissonnas).—Infant of medium development. No eczema; no enlargement of the lymph-nodes; no rise of temperature. Respiration quiet, little stridor in the sitting position, more when lying down. Thorax normally developed, no retraction of the sides. Very distinct dulness over the sternal manubrium, extending beyond it both on the right and left. When the infant entered Professor Kummer's service it was in a state of a very serious paroxysm of suffocation, but digital examination of the epiglottis revealed nothing abnormal, and there was no goitre. There was the characteristic re-

sistance in the supra-sternal fossa at the time of expiration. Respiratory circulatory and digestive systems normal.

Diagnosis.—Percussion and palpation lead to the very probable existence of an hypertrophied thymus gland and in absence of any other explanation for the dyspnœa, it seemed logical to attribute it to compression of the trachea by an enlarged thymus.

Operation (March 21, 1912).—Light chloroform narcosis. Vertical median incision. Exposure of the median rhaphe and retraction of the sterno-hyo and sterno-thyroid muscles. The upper portion of the thymus, which was readily recognized by its lobulated appearance and whitish color, extended about two centimetres above the sternal fork. Incision of the capsule. The left lobe, which extended higher up than the right, was seized with hæmostats and drawn slowly and progressively into the wound. A few ligatures were applied on the vessels going from the parenchyma to the capsule. The extraction of the left lobe, which was quite independent from the right, was accomplished with great ease and was followed by an immediate amelioration in the respiration, so much so that it was decided to leave the right lobe *in situ* since it was much smaller than the left and did not appear to compress the trachea. The latter was somewhat deviated to the right and lacked rigidity and was, perhaps, even a little softened. Suture of the muscles and skin without drainage. Dry dressings.

Pathology.—The left lobe weighed 20 grammes and measured 5 x 3½ x 1½ centimetres. Microscopically, no pathological change could be found in the thymic parenchyma by Professor Askanazy.

Post-Operative Results.—The wound healed by first intention and the infant left the clinic six days after the operation. For the following three months he still suffered some slight difficulty in breathing, probably due to a slight naso-pharyngeal catarrh, but the paroxysms of suffocation completely disappeared.

Two years after the operation respiration was perfectly normal. The baby has developed perfectly and there is absolutely no evidence of thymic insufficiency, naturally because the right lobe was not removed.

Case III.—Infant born at the Maternity of Geneva on March 16, 1912. Labor normal. From birth the infant presented a very dangerous permanent dyspnœa; from time to time there were paroxysms

of suffocation, to such a degree that it appeared as if the child might die in one of them.

Status.—A well-developed infant, no goitre, epiglottis normal, manifest projection of the sternal manubrium with dulness on percussion over the projecting area. A finger placed in the supra-sternal fossa could detect the characteristic resistance of the thymus.

Diagnosis.—Hypertrophy of the thymus, with dyspnœa probably the result of the hypertrophy.

Operation (March 18, 1912).—Light chloroform narcosis. Vertical median incision over the sternal fossa. Incision of the median rhaphe and retraction of the muscles; below the isthmus of the thyroid gland the upper portion of the thymus can be seen, surrounded by its capsule. Both its lobes extend into the cervical region, the left lobe, which extended higher up than the right, was first brought out of the wound and excised completely; the right lobe was then drawn out and the upper half was excised after a ligature of the lobe *en masse* had been done. The trachea was normal. Suture of muscles and skin without drainage. Dry dressings.

Pathology.—The specimen weighed 10 grammes. Histological examination by Professor Askanazy showed that the thymic parenchyma was without any pathologic change.

Post-Operative Results.—After removal of the thymus the respiration became freer, yet some amount of respiratory difficulty remained for severel weeks following the operation, but there was a paroxysm of suffocation and the breathing became progressively perfectly normal.

The wound healed by first intention, and the infant and its mother left Geneva about a fortnight after the operation. We have had news of the baby from time to time and learn that it developed normally without any evidence of rickets.

CASE IV.—Charles S., æt. ten years, brother of the patient whose case is related under No. VI, presented an enlarged thymus made evident by clinical and radiological examinations and by reason of the sudden death of a younger brother (Case VI) from a probable hypertrophy of the thymus the parents were most anxious. The boy had always been well, but presented some puffing of the face and slight cyanosis.

Status.—The boy is well developed for his age; the face is a little

puffed, the cheeks slightly cyanosed, cardiac dulness normal, slight murmur at the base, urine normal. An abnormal dulness could be mapped out over the sternal manubrium extending a little beyond the edge of the sternum on each side; in the sternal fossa a resistance can be made out which disappeared at the time of inspiration. By radiography a shadow was found with its base above and its apex being compounded with that of the heart. Thyroid gland normal.

Diagnosis.—The case is undoubtedly one of an enlarged thymus, which does not cause any clinical disturbance, excepting, perhaps, a little compression and a mild venous stasis in the face.

As to the treatment, if it had not been for the fact that the subject's brother had died from an enlarged thymus, neither the parents nor physicians would have paid any attention to the case. On the other hand, since a certain degree of hypertrophy of the thymus excited in reality and kept up a mild venous stenosis and since the possibility of a familial disposition to thymic accident could not be denied, it appeared legitimate, on account of the small risk of thymectomy in such circumstances, to give way to the parents' wish to deliver the child from all thymic complications, such as had killed the brother.

Operation (January 20, 1914).—Light ether narcosis. Usual incision. The upper portion of the thymus extended beyond the level of the sternal fourchette to the extent of about two centimetres. Incision of the capsule and excision of the upper portion of both lobes. There was only a trifling connection between the vessels of the gland and its capsule. Suture of muscles and skin without drainage. Dry dressings.

Pathology (Professor Askanazy).—Both lobes of the thymus were normal in appearance excepting for some red spots on their surface. Weight, 14 grammes. On section the parenchyma was reddish, with some hemorrhagic foci. Microscopically, hypertrophy of the gland tissue, involving both the medullary and cortical structures, but especially the lymphatic tissue of the latter. Many Hassall's corpuscles could be seen.

Operative Result.—The wound healed by first intention and three months after the operation the boy was perfectly well. The puffiness of the face had diminished.

CASE V.—Female, about two years of age, treated by Doctor Bourdillon for paroxysms of suffocation, which he regarded as being

thymogenous in nature. The patient was referred to Professor Kummer for operation. A characteristic dulness over the sternal manubrium and a very distinct resistance at the time of expiration in the supra-sternal fossa made the diagnosis of hypertrophy of the thymus more than probable, but at the time Professor Kummer made his examination the condition of the child seemed so little alarming that an expectant attitude was adopted and a stay in the country advised, which greatly benefited the child. But when returning to the house after a railroad trip the child died suddenly, apparently in a paroxysm of suffocation.

CASE VI. (Doctor Chassot).—Male, æt. five years and six months. Father and mother in good health. Retro-pharyngeal adenoids removed in January, 1912. Child perfectly well during the summer of 1912.

On September 11, 1912, at 7:30 A.M., Doctor Chassot was summoned in haste and found the child senseless, giving vent to cries and throwing himself on the bed; the child had slept well during the night and it was only in the morning that the paroxysm developed suddenly. Suffocation was not suspected, as there was no tracheal tugging; the face was congested, but there was no marked cyanosis; the pupils were normal and reacted to light. Heart normal; no fever; no vomiting nor opisthotonus. There were no symptoms pointing to meningitis; the room in which the child slept had neither a gas stove nor lamp.

A diagnosis of convulsions from gastric disturbance or from meningism provoked by intestinal parasites was made, because Chassot had previously met with a child of the same age who presented similar symptoms, which quickly disappeared after the exhibition of a vermifuge and the expulsion of ascarides. Some powders containing calomel and santonin were prescribed, as well as mustard to the calves of the legs . Two hours later the child, having had a sudation from the effects of the mustard, became more quiet, but consciousness did not return, so that it was impossible to give the powders. The pupils were still normal and reacted to light and there had been no difficulty in breathing of any kind.

Two hours later the child was dying with a beginning of pulmonary œdema; the pupils were contracted and death took place without a return of consciousness.

Autopsy.—This was done on the following day by Professor

Huguenin. Nothing abnormal in the brain or heart; the lungs were œdematous. Abdominal viscera normal. Finally, to complete the necropsy, the incision was carried up to the top of the sternum in order to remove the larynx with the trachea and then an hypertrophied thymus was brought to light, weighing forty grammes. There was no evidence on the trachea of pressure from the enlarged thymus.

Epicrisis.—Since every other plausible explanation was wanting to explain the child's death, this was attributed to the hypertrophied thymus, the only weak point being that in this case there was no clinical or pathological sign belonging distinctly to a thymic death. If this was actually due to hypertrophy of the thymus, whose reality cannot be doubted, what caused death and by what mechanism did it result?

The clinical evidences do not appear to be those of suffocation; did the hypertrophied thymus produce a direct compression on the large vascular trunks or even on the heart itself? Or might the case have been one of thymic auto-intoxication? These questions cannot, in the circumstances, be solved.

On the other hand, it may well be asked why the thymus, unquestionably hypertrophied for some time, began its lethal action suddenly on September 11, 1912? The child had had no previous dyspnœa or paroxysms of suffocation, but it was Doctor Chassot's opinion that the thymus may have suddenly increased in size following an influenzal infection which at that date was endemic in the neighborhood where the child lived.

Referring briefly to the topographical anatomy of the thymus I would borrow the following description from Olivier's work on the " Anatomie Topographie et Chirurgie du Thymus," Paris, 1911. The thymus may occupy all the area comprised from above downward between the lower border of the thyroid gland and the diaphragm, or at least the area of adhesion of the pericardium to the diaphragm. This may logically be termed the thymic area, the thyroido-pericardo-diaphragmatic space.

The thymic area is a quadrilateral. It may diagnostically, and at all events surgically, be divided into two regions. The first is an upper, or surgical, region of the thymus; secondly, a lower mediastinal region, which is not surgical. The limit between the surgical and non-surgical regions of the thymus is always perfectly distinct and is made manifest externally by the upper border of the sternal

manubrium which, as is known, corresponds behind to the second dorsal vertebra.

The normal weight of the thymus at the various ages of life has been variously and lengthily discussed and no two writers have reached the same conclusions. In the newly born the extreme figures are: From two to three grammes (Sappey); sixteen to twenty grammes (Merkel); while Testut estimates as from six to twelve grammes. According to other writers, any thymus gland in a newly born infant which weighs over fifteen grammes should be regarded as in a state of hypertrophy. I will here append Hammar's table relating to the average weight of this gland, based upon the study of one hundred and twenty-six cases.

Newly born .... 13.26 grammes.
From one to five years .... 22.98 grammes.
From six to ten years .... 26.10 grammes.
From eleven to fifteen years .... 37.52 grammes.
From sixteen to twenty years .... 25.58 grammes.
From twenty-one to twenty-five years......... 24.73 grammes.
From twenty-six to thirty-five years.......... 19.87 grammes.
From thirty-five to forty-five years........... 16.27 grammes.
From forty-six to fifty-five years .... 12.85 grammes.
From fifty-six to sixty-five years .... 16.08 grammes.
From sixty-six to seventy-five years.......... 6.— grammes.

However, too much importance should not be given to these weights. In point of fact, it is not necessarily the very large thymus glands which are the most dangerous; *the situation* of the hypertrophied lobe is by far the most important.

The thymus is contained within an anatomical cavity or space, from whose interior the gland is topographically related to numerous important structures. In front, with the posterior surface of the middle cervical aponeurosis against which it is directly in contact. Behind, with the anterior aspect of the trachea and on its lateral aspects with the primary carotids. Above, the thymus is related to the lower border of the thyroid gland. There are two ligaments which Olivier calls the thyro-thymic, each containing an artery coming from the arch of the inferior thyroids and extending into the upper horn of the corresponding thymic lobe.

As to the horns, their height is essentially variable and, according to Olivier, it is quite impossible to give any statistical figures in this respect.

Lastly, it should be recognized, as Sappey formerly maintained, that the cervical portion may be wanting and that, in these circumstances, the upper end of the thymus does not extend beyond the level of the left brachio-cephalic venous trunk; it then reposes on this trunk and the entire gland will be intra-thoracic in situation.

Within the mediastinal cavity the thymus, surrounded by its capsule, offers extremely important relationships with certain organs. From the surgical viewpoint the capsule of the thymus is, according to Olivier, composed only of a single layer, which shows in serial sections to distinctly surround the entire periphery of the gland.

From its internal aspect the capsule sends off cellular prolongations between the lobules of the thymus which are thus distinctly separated from each other, but an extremely important fact is that these cellular prolongations are very fragile and a stroke of a director is sufficient to break them down so that the gland can be easily enucleated alone, because between the thymic parenchyma and the periphereal capsule a very loose cellular atmosphere exists which renders dissociation an easy matter. On the contrary, the external surface of the capsule continues directly with the connective tissue of the region.

By the intermediary of this capsule, the thymus in the mediastinum is closely related to the arteries, veins and nerves. The large arterial trunks which arise from the base of the heart—ascending aorta and especially the aortic arch, the right brachio-cephalic arterial trunk, then the left primary carotid and left subclavian—are in succession related to the thymus.

The right inferior cardiac nerve which crosses the anterior surface of the aortic arch is intimately in contact with the posterior surface of the thymus. Without referring to the superior vena cava which immediately touches the thymus below, the left brachio-cephalic venous trunk is the organ the most immediately in relation with the thymus. But the phrenic nerves offer especially interesting topographical relations with the thymus as they descend along the sides of the gland, accompanied by the pericardo-diaphragmatic vessels. Let it be recalled that the left pneumogastric is extremely near the gland.

The classic works on anatomy teach that the arteries of the thymus come from the internal mammary artery, above from the inferior thyroid artery and below from the pericardiac arteries and superior diaphragmatic arteries. As to the nerves, according to Olivier, a

single branch has been distinctly put in evidence by dissection, namely a branch issuing from the left phrenic nerve and going to the left thymic lobe; this is Cruchet's nerve.

The thymus is a grayish-colored, lobular organ, whose resemblance to the pancreas had already been pointed out in 1695 by Wharton. The old writers supposed that the gland possessed an excretory duct which terminated either in the buccal cavity, the œsophagus, trachea or even the pericardium, according to their fancy. Becker, in 1826, and Johannes Muller, in 1830, finally classified the thymus in the group of sanguineous glands, along with the thyroid, supra-renal glands, etc.

Each lobe of the thymus forms a homogeneous mass, divided into lobules by connective tissue septums. Hammar has shown that a continuity exists between the lobules and that the organ is composed of a ramified parenchymatous tractus. On section of the thymus a rather distinctly transparent periphereal portion can be made out and a more vascularized central portion.

The thymic lobule is composed by a reticular tissue made up of two distinct elements, the one cellular in nature, the second connective tissue. Hammar has shown that the reticulum represents the most important element of the thymus and that it should be regarded as epithelial tissue of a somewhat different character in the central and periphereal portions.

The second histologic element of the thymus is to be found in the meshes of the reticulum, namely, the cells. A portion of these are derived from the reticular cells and are distinguished from them simply from the fact that they are free in the midst of the parenchyma.

The other cell element is represented by the small cells of the thymus or thymic lymphocytes. The characteristic formations of the medullary portion are: Hassal's corpuscles which, according to Hammar, are to be found in the central portion of the hypertrophied thymus which represents the morphologic expression of the functional activity of the gland. However, this opinion is not admitted by Dustin, Pappenheimer, Lucien and Parisot.

Other cells are found in the thymus called myeloids, which resemble striated muscle fibres, and occasionally there is some aberrant parathyroid tissue present as well. Cystic formation is sometimes noted.

The first experiments in removal of the thymus were undertaken on dogs, in 1845, by Estelli; he likewise used sheep and calves, but the animals always died after a short febrile period. In 1848 Friedleben undertook experiments on twenty dogs and three bitches who all survived removal of the thymus, so that this writer concluded that the absence of this gland did not compromise life any more than extirpation of the spleen. It is interesting to note that after thymectomy, Friedleben's dogs presented changes in the bones—vascular richness, flexibility and delay in growth.

According to the experimental results obtained by Tarulli in 1894, and La Monaco in 1897, the thymus is not an organ essential to life; very young thymectomized dogs showed muscular weakness, a decrease of the blood mass and changes in the bone resembling rickets, but these disturbances disappeared with the progressive development of the animal. In 1903, Basch showed that the excision of the thymus as performed by most experimenters, had been incomplete, and he is of the opinion that of all animals dogs are more sensitive to removal of this gland. Since the thymus in dogs undergoes a rapid involution from the beginning of the second month of life, Basch operated on very young pups, still nursing, and in them he noted bone changes, more particularly, delayed ossification, spontaneous fractures, etc. He also noted a decrease of the intelligence and a change in the psychic state of the animals.

More recent experimenters—Klose and Vogt—have experimented on fifty-four young dogs—ten days old—and after removal of the thymus they noted three phases: the first phase was one of latency; the second, one of adiposity, covering the second and third months following the removal of the thymus, while the third phase was that of thymoprivious cachexia with thymoprivious idiocy arising during the thirteenth or fourteenth month.

Matti, in 1911, noted a delay in growth with softening and inflexion of the bones of the limbs following thymectomy in young dogs, as well as a tumefaction of the epiphysary regions. Other changes following thymectomy are related to change of calcium metabolism, to changes of the figured elements of the blood and hæmoglobin, to changes in the central nervous system, spleen, pancreas, as well as those arising in the various endocrin glands, especially the thyroid, suprarenals, genital glands and the hypophysis.

The intravenous injection of thymic extracts produces, according to Olivier and Schaefer, a fall of the blood-pressure from the effect of a substance probably very closely related to cholin. Attempts at hyperthymisation by injections of thymic extracts have resulted in the production of symptoms of intoxication with fever, muscular contractions and a comatous state.

Minkowsky fed dogs on calves' thymus and found in the urine an organic acid unknown until now, but very similar in composition to uric acid.

Parisot has obtained hypotension by injections of extracts of the thymus glands of normal children and this hypotension was absent when he employed the extract made from the gland obtained from athreptic children. The thymus gland in the latter does not contain lymphocytes, so that Lucien and Parisot believe that the hypotension is an effect produced by lymphocytes. They were able to obtain the same low blood-pressure by injecting extracts of lymph-nodes.

Experiments on hyperthymisation have been carried out by Ranzi and Tandler, who injected extract of sheep's thymus into sheep and they noted an arrested development of the injected animals. Charrin and Ostrowski treated dogs for three to four months with daily subcutaneous infections of from three to four grammes of extract of thymus and noted deformity of the bones in the animals so treated.

Since Kopp, in 1830, laryngospasm in children has been called thymic asthma and cases of sudden death during paroxysms of laryngospasm have been attributed to changes arising in the thymus gland. Friedleben has shown, that the thymus, neither in the normal state nor when hypertrophied, will give rise to laryngospasm and he therefore concludes that thymic asthma does not exist. I shall return to the consideration of this point.

On the other hand, it has been shown that in cases of sudden death in children a hyperplasia of the thymus has been frequently found, and it is difficult to eliminate the idea of a mechanical effect of the hypertrophied thymus either on the trachea or, perhaps, on the heart or the large vessels and nerves of the region. However, some writers, Paltauf, in particular, absolutely reject the mechanical explanation of thymic death. According to the latter writer, these accidents are to be attributed to a constitutional anomaly called *thymolymphatic,* characterized by the following symptoms: paleness of the

integuments, excessive development of the subcutaneous fat, hyper-plasia of the various portions of the lymphatic system, the lymph-nodes of the neck, axilla, mesentery, the follicles of the retrosternal space, intestine, base of the tongue and of the spleen; genital hyper-plasia, small heart, narrow aorta and hyperplasia of the thymus. The latter, according to Paltauf, is not the cause of death, but is merely a symptom of a general disturbance of nutrition characterized by hypertrophy of the lymphatic system.

The pathologic value of this constitutional anomaly consists in a peculiar sensitiveness of the subject to all kinds of morbid influences; in point of fact, 50 per cent. of these hyperplastic subjects die before the age of twenty-five years. As to the cause of death in the thymolymphatic state, Paltauf admits an arrest of the heart's action resulting from a pathologic disposition of the nervous system, the cardiotic tracts in particular.

Laterly, Witzel has insisted upon another way of looking at the process. According to his way of thinking, the Hatus lymphation is not always the expression of a constitutional anomaly, the tumefac-tion of the follicular lymphatic apparatus being frequently consequent upon an infectious inflammatory state and the tumefaction of the thymus, whose parenchymatous cells are closely related to the lympho-cytes, should have the same cause as the lymphatic enlargement itself.

Svehla, basing his opinion on the effect of extracts of thymus gland on the heart, as well as the lowered blood-pressure which results, explains thymic death in infants with hypertrophy of this gland by an exaggerated absorption of thymic matter, in other words by hyperthymisation.

Hart, Schmidt, Rachford and Pend have lately emitted the opin-ion that primary hyperplasia of the thymus, with a pathologic hyper-secretion of this gland determines a retention of toxic products of metabolism in the organism and tumefaction of the lymphatic system and the sudden death of the subject should be due, according to them, to the result of metabolic intoxication.

Although it occasionally happens that death is the first evidence of hypertrophy of the thymus, there exist a certain number of signs of the affection to which Olivier has applied the term of " *the minor signs of hypertrophy of the thymus,*" in opposition to a sudden death. These signs are of both a functional and physical nature.

FUNCTIONAL SIGNS

(a) *Permanent Dyspnœa.*—This is often associated with abdomino-cervical tugging and accompanied by hoarseness. The dyspnœa is peculiar, inasmuch as it is increased by extension of the head, the prone position or in an examination of the throat. This dyspnœa may be explained by compression of the trachea, the thymus being pushed into the sterno-costo-vertebral ring like a wedge. The dyspnœa thus produced immediately disappears after excision of the thymus, as has been noted by Marfau, Barbier, Méry, Parturier, Rehn, Ehrhard and others, as well as in the instances reported in this paper.

In two of Professor Kummer's cases the dyspnœa disappeared immediately after thymectomy, and in one of these in which the breathing was particularly labored before operation it at once became quiet as soon as the gland had been removed. It is true that in the days following, the respiration occasionally became labored at times, but it became progressively normal in every respect.

(b) *Paroxysms of Suffocation.*—" On the common ground of permanent dyspnœa with tugging," said Moizard, " more accentuated accidents become grafted; attacks of suffocation, with or without cyanosis, of more or less long duration, and which may be accompanied by foci of pulmonary congestion." Professor Kummer has twice operated in urgency on children during a paroxysm of suffocation and in both instances the attack was cut short by thymectomy. One of these patients is now perfectly well, the other died from a complication, an accidental lesion of the trachea due to a glass drainage tube.

We are yet rather in the dark as to the pathogenesis of these paroxysms. They are not due to spasm of the glottis, because, according to Moizard, intubation will not control them. It is, perhaps, the result of congestion of the mucosa of a compressed trachea, perhaps phrenic spasm or yet a cardiac effect, but all these are of little consequence since we know that excision of the thymus does away with the paroxysms.

A paroxysm may result very rapidly in death, before medical aid can be got, and this occurred in Case V, where, after a long railroad journey a paroxysm occurred when the patient arrived in the station and death from suffocation in all probability took place almost suddenly.

As to the death of Doctor Chassot's patient (Case VI), it is much more difficult to explain. It would seem to have been a thymic death, but did not appear to have had suffocation as a causal factor. It is nevertheless very possible it could have been avoided by thymectomy, if circumstances had permitted the operation to have been done.

(*c*) *Stridor.*—Stridor is characterized by noisy and increasing respiration, which sometimes takes on the acute sound of a cock's crow when the breathing is precipitate. What is the value of this sign? Has it a thymic or laryngeal origin? The subject is moot; what can be affirmed is that before attributing congenital stridor to hypertrophy of the thymus, it is most important to make a digital examination of the epiglottis and to assure one's self that a flag-shaped epiglottis is not present. Then, and then only, congenital stridor may have a real diagnostic value, if other signs militate in favor of hypertrophy of the thymus. In the case of the two-day-old infant (Case III), there was a mild degree of congenital stridor without any deformity of the epiglottis; the stridor disappeared after thymectomy, so that it would seem clearly the result of the condition of the thymus.

(*d*) *Dysphagia* is a rather frequent symptom observed in cases of hypertrophy of the thymus. I have met with it also, but it has a lesser diagnostic value than the three preceding signs.

PHYSICAL SIGNS OF HYPERTROPHY OF THE THYMUS

(*a*) *Bulging of the Sternal Manubrium.*—This symptom was distinctly evident in one of the cases here recorded.

(*b*) *A sensation of a supra-sternal mass* perceived by the pulp of the examining fingers when the supra-sternal fossa is pressed upon. This is a valuable sign and was present in several of the cases reported in this paper.

(*c*) *Percussion of the area of the thymus* gives rather uncertain results, but for all that it should never be omitted. Although absence of distinct dulness is not of any particular value, its presence, on the contrary, may confirm the diagnosis of hypertrophy of the gland rendered probable by other signs.

(*d*) *Radiography* is of great diagnostic value. A shadow is usually seen extending from the manubrium to the cardiac shadow; it is also useful in making a differential diagnosis between thymic hypertrophy and tracheo-bronchial adenopathy.

(*e*) *Intubation.*—Rehn and Ehrhard have made the diagnosis of hypertrophy of the thymus by means of intubation. In infants this diagnostic procedure is often difficult to carry out, not to say dangerous.

Three operations of very different nature have been proposed for dealing with hypertrophy of the thymus, namely, exothymopexy, excision of the sternal manubrium and thymectomy. Excision of the manubrium was performed by König with the object of enlarging the sterno-costo-vertebral space. It has very limited indications; therefore, it needs no further consideration.

Exothymopexy performed by Rehn is unquestionably an easy operation, but it singularly complicates the healing of the wound and offers no advantage over partial thymectomy, which is the procedure of choice. It is practically impossible to do an absolutely complete thymectomy in man, because some glandular lobules will almost certainly be left behind in the mediastinal cavity and from animal experiments it is known that very small bits of the gland left *in situ* are sufficient to assure a partial regeneration of the thymus and thus prevent the development of thymoprivous symptoms.

Nevertheless, the rule is never to attempt more than a partial excision of the thymus in cases of thymogenous dyspnœa, all the more so because a more or less extensive reduction in the size of this gland is enough to do away with the dyspnœa.

As to the modalities of this reduction, it is impossible to formulate any hard and fast rules. In some cases excision of one lobe will suffice; in others, excision of the upper portions of both lobes will be indicated, while in still others, excision of one lobe and partial excision of the second will be required, according to circumstances. In the cases of thymectomy reported in this paper symptoms attributable to thymic insufficiency were never noted after the operation. From this point of view the post-operative history of the two-day-old infant (Case III) offers particular interest.

Narcosis was employed in most of Professor Kummer's operations with complete success, this being quite in opposition to what might have been feared, according to the effect attributed to the thymus in death from chloroform. Both chloroform and ether were well supported by the patients.

A vertical or horizontal incision exposes the supra-sternal fossa. An exact hæmastasis is assured by the use of hæmostats in the veins

of the region. There are no arteries requiring ligation. The super-
ficial cervical aponeurosis having been incised in the median line the
muscular plane of the sterno-hyo and sterno-thyroids is exposed, which
is divided in the median rhaphe. The cellular space is then exposed,
at the bottom of which is to be found the trachea, the thyroid gland
above and the thymus below. The latter is visible through its cap-
sule, which is formed by a thin fibrous membrane, which is either
incised or torn through.

The thymus thus exposed is seized with hæmostats and drawn
up into the incision. As the parenchyma of the gland is rather friable,
gentle and progressive traction must be used, while the few vessels
going from the capsule to the glandular parenchyma should be ligated
as fast as they appear. Excision should commence with the lobe which
comes up the highest in the cervical region and it should stop at the
point thought to be the best, either from the point of view of the com-
pression or from that of the functions of the remaining portions
of the gland.

A single suture in the muscles and suture of the skin completes
the operation. Drainage is useless and a dry dressing held in place
by collodion is sufficient.

The immediate results of the operation are usually excellent. As
soon as the thymus has been removed, breathing becomes normal and
the child's face assumes its normal color. In the days following the
operation there should be no elevation of the temperature and the
wound heals by first intention.

In those cases where tracheotomy has been necessitated, suppura-
tion of the wound has invariably occurred, so that this complementary
operation should always be avoided when possible. Tracheotomy
likewise is prone to give rise to post-operative bronchitis or broncho-
pneumonia, all the more readily because subjects with thymogenous
dyspnœa frequently have some catarrhal process of the respira-
tory tract.

One of the most recent statistics of thymectomy for thymogenous
tracheostenosis was published in 1913 by Klose. Out of a total of
fifty-six operations there were forty-three recoveries and thirteen
deaths, therefore a total mortality of about 23 per cent. Of the thir-
teen fatal cases, two were the result of mediastinitis, one to a delayed
operation, four to cardiac adynamia and six to intercurrent affections.

To calculate the operative mortality, properly speaking, it seems permissible to eliminate the three last categories of death and only retain the two cases of mediastinitis, in which case the operative mortality will be found to be only 4 per cent., a percentage which does not seem to me high if the gravity of the situation of many of these patients be taken into consideration.

König is the only writer who has recorded a case in which, after thymectomy, the patient developed symptoms which may be regarded as thymoprivous in nature. This was a case of rickets arising in a child who had previously undergone thymectomy, but there is nothing which might lead one to assume that the rickets might not have developed without excision of the thymus having been done. This appears even probable because the thymectomy in question was probably not complete, and after the results observed in animals total excision of the thymic tissues appears to be necessary for the production of bone lesions. In no other case with which I am familiar has excision of the thymus been followed by thymoprivous symptoms, and all the patients have returned to a state of perfect health.

Although the treatment of hypertrophy of the thymus with the X-rays does not enter into the subject of this short paper, I deem it necessary to refer to it briefly in order to bring into relief the importance of surgical treatment.

In point of fact, the effect of the X-rays on the thymic tissues may be disastrous. The hypertrophied thymus is extremely sensitive to X-rays; following a single séance of merely momentary irradiation profound histologic changes can be detected in the parenchyma of the gland, such as immigration of myelocytes and lymphocytes, changes in the reticular cells and disappearance of the differentiation between the cortex and marrow.

Following two instantaneous exposures to the X-ray, Klose observed disorders that he qualifies as " fragmentation of the thymus," consisting of profound degradation of the gland, myelocytes containing débris of lymphocytes and transformation of lymphocytes into fusiform cells.

Without denying the possibility of ultimate repair of these changes, the practitioner will reflect at least twice before assuming the risk of producing such changes by radiotherapy in young children,

whose organism might thus be exposed to serious disturbances which may be permanent. Boissonnas has for that matter, observed the development of a paroxysm following an exposure to the X-rays.

CONCLUSIONS

Whatever may be the final factors of thymic death—thymolymphatic state, compression of the trachea, nerves or heart, hyperthermisation or metabolic intoxication—one thing is certain and that is the favorable results obtained from excision of the gland on thymogenous dyspnœa. An important fact to note is that up to date no authentic case of thymoprivious cachexia has even been met with following thymectomy in man. This can be readily understood if it be recalled that it is a matter of utmost difficulty to perform complete, total thymectomy and, on the other hand, a small bit of thymus can regenerate a neothymus capable of assuming the entire endocrine functions of the primitive gland.

Given the favorable results obtained by operative treatment of hypertrophy of the thymus, physicians have at last understood that inaction inspired by purely theoretical views as to the nature of the thymolymphatic state is no longer permissible to-day. And yet more, if it be permitted to take into consideration Vibert's and Taylor's statistics, which for the single city of London show that there are four hundred cases annually of death from thymogenous compression in children, an idea may be formed of the immense good thymectomy will give in the future. For the time being, many very delicate questions remain to be solved, such as the operative indications. When should thymectomy be done and what degree of thymic hypertrophy requires operative treatment? How can the dangers arising from thymic compression be foreseen? Is a preventive operation admissible and in what conditions?

It will be only by the collaboration of physicians and surgeons that a reply to these questions may be looked for.

Industrial Medicine

INDUSTRIAL SURGICAL CLINICS

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COMPRESSION FRACTURE OF THE SPINE WITH REFERRED PAIN, LOSS OF BALANCE AND LOW BACK PAIN

S. M., aged twenty-seven. Examined April 3, 1920.

History of Present Condition.—This man says that on June 13, 1919, he was caught while in a stooping position, between the mine rib and a car, and flexed sharply forward. He had immediate and severe pain in the back and was unable to rise to a standing or sitting position. He was taken home, placed in bed without extension and the doctor told him that he had a broken back. He was allowed to lie in a position of semi-flexion of the body for about three months, when a plaster cast was applied and he was allowed to be up and around. He complains now of pain around the waist, a numb feeling on the outside of the right hand and pain at the junction of the lumbar and sacro-iliac region on both sides. The latter, he says, is the thing that gives him the most trouble, as it does not allow him to be on his feet for any considerable length of time, or to stoop over to lift anything.

Examination.—Spine shows an acute kyphos about the tenth, eleventh and twelfth dorsal, the patient being thrown markedly forward above the point of angulation. The lumbar curve is more flat than normal. Pressure downward on the shoulders does not give pain. Pressure over the site of angulation does not give pain except laterally about one and one-half to two inches away from the median line on either side, at which points he complains of tenderness. His greatest complaint is of pain and tenderness at the insertion of the lumbar muscles in the lumbo-sacro-iliac region and this is his point of constant pain.

There is an old fracture of the right clavicle which is healed by firm, bony union and there is discovered an anæsthesia over the ulnar nerve below the elbow with some atrophy of the interossii and the two ulnar lumbricales. This is probably due to an injury to the cord of the brachial plexus, where it runs under the clavicle.

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The X-ray of the Spine by Dr. Hollis E. Potter, shows a very pronounced fracture, the findings of which centre at the twelfth dorsal vertebra. In the antero-posterior plate there is seen to be a pronounced displacement of the eleventh dorsal on the twelfth, the displacement being toward the left. There is much callus about the tenth, eleventh and twelfth dorsal, most visible on the right side. Lateral plate of the dorso-lumbar region shows a very pronounced compression of the twelfth dorsal vertebra to the extent that the anterior portion of the body is reduced in height to about one-quarter inch. There is also seen to be displacement in the region of the laminæ, in which the upper structures are slipped forward on the lower. These changes result in pronounced kyphotic deformity, most measurable at the anterior profile of the bodies. There is no lesion demonstrable below the first lumbar vertebra. The architecture of the sixth lumbar which is present in this case, is peculiar in that it lies low between the ilii. There is an appearance of crowding between the transverse process of the sixth lumbar and the adjacent ilii. (See Figs. 1 and 2.)

Comments.—It has many times been brought forcibly to the attention of the authors that unless a compression fracture of the spine is extreme, it is difficult to detect it in an antero-posterior view. Therefore, all injuries to the spine should be rayed laterally or, at least, diagonally, to get any reduction in height of the bodies of the vertebræ anteriorly. Rotations, of course, are best shown in antero-posterior views, as are lateral displacements.

The callus at the point of fracture in this case explains two things: First, the entire lack of pain at the site of injury which has been permanently and firmly immobilized by this callus, and, second, the girdle pains of which this man complains. These appear usually somewhat late in fractures of the spine where there is callus formation and are due to pressure on the sensory nerves as they exit from the spine. It will be noted that in this case there was lateral displacement as well as antero-posterior displacement. There was, therefore, considerable tearing of the ligaments as well as crushing of the bone, which probably stripped up the periosteum and aided in callus formation, which was nature's effort to repair this condition. These girdle pains cannot be relieved by any operation or any means known to the authors, inasmuch as pressure cannot be removed by anything except absorption of callus, which will probably take place to a certain extent in another twelve to fourteen months, which may somewhat alleviate the patient's symptoms.

The trouble with the ulnar nerve cannot be relieved with any considerable degree of hope of success without a severe operation, and inasmuch as the patient is not seriously inconvenienced by this dis-

ability, it would be advisable to ignore it, all the essential motions of the hand being present, although the strength is diminished.

The thing that is disabling this patient now is the fact that he has constant and severe pain in the lumbo-sacral region, which prevents him from assuming an upright position and maintaining it for any considerable length of time, and also prevents him from stooping over to lift anything from the floor. This is easily explained by referring to Fig. 2. We have here an angle of about 130 degrees at the junction of the eleventh dorsal with the first lumbar, the twelfth dorsal having been crushed out. This throws the upper part of the patient's body at a very considerable angle to the perpendicular and forces his lumbar muscles to support him in what amounts to a semi-stooping position continually. This, as anyone knows who has stooped over the engine of his automobile to tinker with the carbureter for any considerable time, is an extremely difficult position to maintain with any comfort, and gives one acute pain in the lumbar muscles. If this strain can be removed, the patient will be relieved, and since we have no way of correcting his position, we must support the lumbar muscles and relieve them from this excess strain, which will relieve the patient of his symptoms.

Practical Anatomy.—There are three portions of the spine which are favorite locations for fracture dislocations. The cervical-dorsal junction, the dorso-lumbar junction and the lumbo-sacral junction. These are the three points where there is a comparatively fixed and a very movable segment of the spine joining. These are the three most frequent sites of fracture. Of these, the dorso-lumbar is by far the most frequent.

If force is applied from above downward with the patient in a semi-flexed position, the shoulders being driven toward the knees, the pelvis being fixed and the ribs fixing the dorsal region, a lever is formed above and below, supplied by the ribs on one end and the lumbar muscles on the other with the fulcrum at the twelfth dorsal and first lumbar, and the body of the vertebra is crushed between these two opposing forces.

If the force is applied lower down than the shoulders, more nearly at the middle of the dorsum with the hips fixed, then the pressure falls at the lumbo-sacral junction and the fifth lumbar is the sufferer.

Injury to the seventh cervical is often complicated by injury to

Fig. 1.

X-ray (Dr. H. E. Potter).   Antero-posterior plate shows a pronounced displacement of the 11th dorsal vertebra on the 12th, with much callus about the 10th, 11th, and 12th dorsal (Case S. M.).

Fig. 2.

X-ray (Dr. H. E. Potter). Lateral plate, Case S. M., shows a pronounced compression fracture of the body of the 12th dorsal vertebra.

Fig. 3.

Taylor spine brace.

the skull and is consequently sometimes overlooked in the more severe injury to the head. It is often fatal on account of immediate injury to the cord which is larger and less protected by strong ligaments and muscles in this region.

It is important to look for compression fracture of the spine in all injuries where the patient is in a stooping position and is struck by any considerable weight from above, forcing his head and shoulders downward and forward toward his knees, the authors having seen a large number of fractures of the spine within the last six months which have not been recognized and which have not been treated for a period of six months to two years.

Treatment.—Immediate treatment of this case should have been immobilization in bed with extension and counter-extension, and mild pressure under the point of greatest deformity. This extension should be applied by halter under the patient's chin and occiput, fastened to the head of the bed, the bed being raised at its head about six inches. A small pillow should be placed under the back at the point of greatest deformity and a Buck's extension applied to both legs and run over pulleys at the foot of the bed with about three to five pounds' pull on each leg. This pull should be maintained continually over a period of four to six weeks. This would have had a tendency to somewhat reduce a severe deformity. It would have kept the patient immobilized so that the callus could have formed and permanently immobilized the spine in a more favorable position for the comfort of the patient in future and for the reduction of his deformity. It would also have tended to open further the exits for the spinal nerves and prevent pressure from acute forward flexion, thereby lessening the probability of referred pain, such as is seen here.

This should have been followed by application of a Taylor spine brace (see illustration Fig. 3), the mechanical principle of which is simple and apparent. Let us call attention here to the fact that no support can be had from any type of brace which depends for its strength on crutches which fit under the arm. The shoulder is a movable member, and no pressure can be applied under the arm sufficient to raise the upper part of the body and take the weight off the injured spine, without putting pressure on the brachial plexus which will

produce a crutch paralysis. Therefore, all types of spine brace which depend on this means of support should be immediately discarded.

The Taylor spine brace consists of two strong flat steel bars, running from the shoulders on each side of the spine, down to the centre of the sacrum. These are placed about one and one-half to two inches apart, so that any pressure which has a tendency to straighten the spine will be applied over the great muscles of the back and not over the spinous processes. These bars are padded sufficiently to be comfortable. The support of this brace is secured by, first, a tight belt around the pelvis, which is to be considered one fixed point, and, second, around the upper part of the chest, which is to be considered another fixed point, forming two ends of a lever. The pressure of the bars should come at the point of greatest deformity, and form the fulcrum. In other words, the two bars press forward at the point of greatest backward curve in the spine and the two ends of the bars, namely, the shoulders and the hips, pull backward, which takes the strain off the erector spinæ group of muscles and immobilizes the spine by its two fixed points or two ends of the lever.

At this time, ten months after the injury, the only thing which can be accomplished in this case is relief of the pain in the lumbo-sacral region. This can be secured by the application of the Taylor spine brace, just described. The physician must see to it that this brace performs its proper function by proper fitting, to constitute the mechanics of action, otherwise nothing can be gained. Sending the man to a bracemaker with directions to make a brace for this individual without knowing what is to be accomplished by this brace and without knowing the mechanical principles which are involved is exactly as sensible as sending a man to the druggist with the request that the druggist give him something to cure typhoid fever. Nevertheless, this is the thing which is done every day and the patient pays the fiddler.

Report Three Months After Beginning of Treatment.—Within the last few days a letter has been received from this patient in which he states that he is able to do light work all day and do the ordinary getting around with a great deal of comfort. He still has the referred pains around the lower part of the ribs, but his backache has entirely disappeared unless he rides on a vehicle over rough roads for a considerable length of time, after which the pain in his back returns. He

is extremely grateful and states that without his brace he would be a total invalid, but with it he feels almost like a man again and is able to do a considerable amount of work.

A CASE OF HYSTERICAL MONOPLEGIA

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J. T., aged twenty-eight years. Married thirteen years; one child, 12 years of age, living and well. The family history is negative as to any neuropathic taint or alcoholism. Of previous illnesses the patient had an attack of acute articular rheumatism six years ago, affecting both arms and legs. Following this for a period of two years he had manifestations of a subacute nature off and on. Fifteen years ago he suffered from an attack of malaria.

The patient comes from a family of apparently industrious and intelligent people. He received a fair education in Italy and was successful in his pursuits prior to his arrival in America. He left Italy to avoid military service and since his arrival in the United States has been an industrious and successful laborer. He is apparently happily married and does not seem to have any conflict with social conditions to which he has not properly adjusted himself.

On August 7, 1919, while employed by a coal company, he was lifting a coal car, which, tipping up, struck him with the car hook, to the right of the dorsal spine. He was knocked down from a crouching position and was assisted by another man to arise and walk to another car. On this car he rode a distance of a mile and then walked a quarter of a mile to his home. It is notable that there was no period of unconsciousness. When the doctor was called to see him, shortly after he reached home, he could hardly talk, his right forearm was flexed to a right angle and the movements of this arm gave rise to considerable pain in the back. His left arm was flaccid and he states that he was unable to move it. Since that time he has been unable to actively move any part of the left arm, forearm, wrist or hand. He was able to leave his bed in a few days, but as time progressed, developed difficulty in walking, throbbing pains in his head and spine and attacks in which he states "his brain gets blind." These attacks were usually precipitated by some effort, such as walking or visits to a physician, or conditions under which he would be required to concentrate his thoughts. At times during these attacks he would seem to faint and would remain in a dazed state for a number of minutes.

Throughout his illness he had been seen by a number of physicians but in no instance had a definite diagnosis been transmitted to the patient, nor an assurance of recovery given to him.

I examined him April 8, 1920. In the field of motility there was a paralysis of all the movements of the left arm, forearm, wrist and hand. He was unable to shrug his shoulder, but the sterno-cleido-mastoid functionated properly. The paralysis was flaccid. It was

noted that the extremity at no time interfered with motion of any other part of the body. Without any apparent realization, the paralyzed extremity was always manœuvred in some way so that it would not interfere with other movements. There were no contractures and only such atrophy as could be explained on the basis of disuse was noted. The achillis jerks, the knee jerks, the wrist, ulnar, biceps, triceps and jaw jerks were normal. The plantar, cremasteric and abdominal reflexes were normal and equal upon both sides. The pupils were regular, equal in size and reacted promptly to light and accommodation. Electrical examination revealed normal reactions in all the paralyzed muscles. Sensory examination revealed a loss of sensation in all modalities; deep sensation, muscle and joint sense, touch, pain and temperature sense were all absent over the arm, forearm, wrist and hand. The upper limit of this analgesia was an everchanging line at times extending only to the shoulder and at other times over a considerable portion of the upper part of the chest on the left side. No difference in temperature or vasomotor control upon the two upper extremities was noted. The cranial nerves were normal.

Differential Diagnosis.—The paralysis which we have observed must be the result of causes acting in one of three groups: First, an organic lesion of the central or peripheral nervous system; second, hysteria; and, third, malingering. If the two last groups be associated together as producing functional paralyses, we must first concern ourselves with the differentiation of a functional from an organic lesion. Functional disorders differ from those produced by organic lesions in two directions. First, in the absence of the logical physical consequences of an interruption of certain tracts or removal of the function of certain areas of the brain; and, second, in the addition of signs and symptoms which could not be produced by any lesion in the central or peripheral nervous system. If the monoplegia with which this patient was afflicted had been caused by an organic lesion, such an injury could have affected the central nervous system at any point cephalod to the anterior roots. If the paralysis were consequent to an injury to the brain there would have been an initial loss of consciousness. It is probable that there would have been a paralysis of the left leg as well. Such a paralysis would have shown a tendency to recede. If the sensory disturbances were due to a lesion of the cortex they would have dealt more with discriminative sense than

with entire loss. If they were due to a subcortical lesion, paralysis
of the leg could not have been avoided, inasmuch as the lesion would
have to be in the internal capsule. If we were dealing with a cortical
lesion, Jacksonian or motor fits would undoubtedly have been observed.
A paralysis consequent to an injury of the upper motor neurone, as
would have been produced by a lesion in the brain, would have been
a spastic one and contractures would have been present.

It is readily seen that without the assistance of a negative röntgen-
ological examination a cerebral injury can be ruled out. The patient
showed no cortical fits. There was no spasticity, no increased deep
reflexes, no pathological reflexes, such as a Babinski sign, and the
distribution of the paralysis and analgesia was such as could not have
been produced by a cerebral lesion.

If we were dealing with a lesion in the spinal cord at the seg-
mental level of the nerve supply to the left upper extremity, there
would have been found increased deep reflexes upon that side below
the level of the lesion. There would have been a Babinski, Gordon,
Oppenheim and Chaddock sign. There would have been bladder and
rectal disturbances manifesting themselves by slight retention of
urine and constipation. At the level of the injury the muscles sub-
served by the ganglion cells would have shown atrophy and reaction
of degeneration. More striking than all of the preceding manifesta-
tions are the sensory changes which would have followed a unilateral
lesion of the spinal cord at such a level. There would have been an
anæsthesia to touch upon the side of the lesion, distributed over the
arm, trunk and legs; but it would have been upon the opposite side
of the body that the insensibility to pain and temperature sense
would have been found, because the fibres subserving these functions
cross in the spinal cord. Finally, were it considered that the lesion
affected only the gray matter of the spinal cord the muscles would
have shown atrophy and reaction of degeneration, and if any sensory
disturbances would have been present they would have been dissoci-
ated; that is tactile sensibility would have been preserved and only
pain and temperature sense lost.

If we were dealing with a lesion in the peripheral nervous system,
all the deep reflexes of the left upper extremity would have been
absent. The muscles would have shown reaction of degeneration,
atrophy and probably other trophic disturbances. This distribution of

the paralysis and of the sensory disturbances would have followed a definite anatomical rule. If, for example, the trapezius had been paralyzed the sterno-clcido-mastoid which is supplied by the same nerve, the spinal accessory, would likewise have been paralyzed. Certainly no sensory disturbances would have been found upon the chest unless they extended to the midline.

The signs and symptoms which this patient presented did not fulfil the requirements necessary for the inclusion of the condition into the organic group produced by injury of the central or peripheral nervous system.

What were the signs and symptoms which, aside from the method of exclusion, pointed to the functional nature of this condition? Inclusion of movements of the shoulder muscles which were supplied by a cranial nerve; the hypothecated sensory disturbances to correspond to the paralysis; the marked shifting of the border of sensory loss; the completeness of the paralysis of all the muscles, and finally, the significant fact that despite complete analgesia there was not present the slightest sign of injury, such as a burn, scratch or bruise of the paralyzed extremity.

Having decided that we are dealing with a functional condition how may we differentiate hysteria from malingering? Both conditions are produced by hypothecated or simulated signs and symptoms. Psychologically the essential difference lies in the fact that the malingerer is conscious of the fact that he is hypothecating an illness. Both states result from an illicit motive, but the consciousness of the motive produces certain psychological reactions which may be recognized in many cases. The hysterical individual welcomes examination, whereas the malingerer avoids it. The signs and symptoms of hysteria are consistently repeated, whereas those of malingering frequently change from time to time. The malingerer may readily be detected in his deceit; whereas the hysterical individual is unconscious of his analgesia, the malingerer frequently calls attention to its presence. The malingerer will attempt to defend the inconsistencies presented by his condition, whereas the hysterical individual does not try to justify his condition. Frequently the differentiation is difficult but usually the malingerer reveals himself to a careful observer.

Pathogenesis.—It is widely accepted that the neuroses are a result

of a conflict. In civil practice this conflict is most frequently associated with the instinct of propagation of species and therefore related to sex in a broad sense. In the war it was found that the conflict dealt chiefly with the instinct of self-preservation. The cases of hysteria arising in industrial medicine follow more closely the conflict of the war. Such a conflict is the inability of an individual to sublimate his desire, whatever it may be, safety, compensation, sexual desire, gratification of any wish, and the social condition and circumstance which prevents the consummation of such a wish. In this light compensation, which answers the confusing problem related with resumption of occupation and support of his family as well as the regaining of his health, assumes an important rôle. In this regard, compensation postpones the struggle for existence, which the patient dreads subconsciously in the light of his injury, which he fears has produced an irreparable damage to his physical or mental state. It is important to recognize the fact that for the recovery of the patient it would be far better if no compensation were to be expected. If, under existing conditions, compensation for functional ailments is expected, demanded and given, such compensation should be in the form of a lump settlement and the decision of an industrial board be so arranged that no further compensation could be obtained and the case immutably closed. As long as litigation is pending, the treatment of the neuroses will be found to be unsatisfactory and unsuccessful.

Treatment.—What can be done to remove the symptoms of hysteria? They have been successfully treated for generations by many methods. The water of Lourdes has cured them, mesmerism, hypnotism, "laying on of hands," the "king's touch," Christian Science, all have innumerable cases credited to them as cured. They have been cured by psycho-analysis and by suggestion. Suggestion has been employed in conjunction with painful stimuli with electricity, faradism to move muscles, anæsthetics, and even magnetic belts.

In this case, after the patient was carefully examined, it was explained to him that no organic lesion existed. He was told that the memories of movements of his arm had been pushed aside and that if they could be recalled by making the muscles move through the application of an electric current, that he would be able through repeated and continued efforts to regain the use of his paralyzed arm. Faradic stimulation produced movements in these muscles and after long-con-

tinued insistence that he will the movements of the muscles being stimulated, a contraction of the biceps muscle was obtained. From this point recovery was rapid, and within three days the extremity which had for nine months been completely paralyzed was moved in every direction to the fullest extent. For some time after the recovery of movement he complained of some pain, but reëducational movements were insisted upon despite pain and recovery ensued.

Whatever rôle suggestion may have in the pathogenesis of the stigma of hysteria, it is evident to me that whatever method was used to treat them it was suggestion which produced their disappearance. If, after a careful examination, a correct diagnosis was made, and the patient had faith in his physician, it was necessary only to convince him that he had a curable disease, that the physician could cure him and that the particular method contemplated was the one to accomplish the end. Whatever technic may be employed, whatever atmosphere may be created, or whatever mechanism be invoked, suggestion does the work.

OPEN TREATMENT FOR UNUNITED FRACTURE OF INTERNAL MALLEOLUS

J. O'S., aged forty-five. Laborer.

History of Present Condition.—On March 27, 1919, over a year ago, a wheelbarrow fell from a platform about fifty feet above where this individual was working, and in its descent the handles struck the patient in the left side and over the ninth, tenth and eleventh ribs, in the left lumbar region and over the outside of the left leg, which was in a position of approximately a 60 degree angle with the ground. The force of the falling object drove the inside of the leg towards the ground and the patient suffered a fracture of both bones at the ankle joint. His leg was put up in a cast without inversion, but with the foot at right angles to the long axis of the leg. The injury to the ribs was treated by strapping with adhesive plaster.

The patient now complains of pain in the left side, in the intercostal spaces between the ninth, tenth and eleventh ribs, pain in the left ankle, especially on the internal surface; this pain becomes more marked when an attempt is made to invert the foot and dorsi-flex it.

Examination (April 21, 1920).—Examination shows enlargement of the ninth, tenth and eleventh ribs to the left of the erector spinæ muscles. There is no tenderness over these enlargements, but when the ribs are compressed, it increases the pain.

Examination of the ankle shows almost an entire loss of lateral motion, the internal malleolus not prominent, dorsi-flexion beyond a right-angle impossible, plantar flexion nearly normal. There is tenderness on pressure at the point of the internal malleolus which seems to be displaced anteriorly and towards the outer side of the ankle joint.

X-ray by Dr. Hollis E. Potter: Show the results of a Pott's fracture in which the outer malleolus was broken about one and one-half inches above the tip and now shows bony union in a very fair position. The inner malleolus was fractured and shows no bony union and is displaced outward along with the astragalus and somewhat forward. (See illustration Fig. 4.)

The X-ray of the chest shows there is deformity of the ninth, tenth and eleventh ribs, which evidences healed fracture a few inches outside of the articulation with the spine.

X-ray of the lumbar region shows the left transverse process of the second, third, fourth and fifth lumbar vertebræ were fractured off and now lie detached from the vertebræ.

Operation.—Patient was operated upon April 26th, at which time a curved incision was made behind the internal malleolus, following the posterior tibial tendon and the flap of skin pulled forward, exposing the internal malleolus which lay at an angle to the long axis of the tibia with the tip of the internal malleolus pointing downward and forward into the angle between the astragalus and the scaphoid. This was dissected out and entirely freed from its attachments, the fractured surface was cleared of fibrous tissue on both the upper and lower fragments. A drill was run perpendicularly through the tip of the internal malleolus up into the tibia; an ivory nail was driven through this drill hole, fastening the internal malleolus to the tibia. The wound was closed and the ankle placed in a cast with the foot in inversion. The cast was allowed to remain in position for two weeks, at which time massage and active and passive motions were instituted. Patient remained in the hospital until June 4, approximately five weeks, and left the hospital walking with a cane only, whereas, he came into the hospital with two crutches.

X-ray plate (Fig. 5), by Dr. Gray Chandler Briggs, St. Louis, Mo., shows the ankle as it appeared on June 24th, about two months following the operation.

Comments.—Fracture of both the internal and external malleolii is an extremely difficult one to maintain in position without open fixation of either one or the other of these bones, since they form the mortis which holds the astragalus in position. If the foot is strongly inverted, where both internal and external malleolii are fractured, it is very easy to displace the astragalus inward because there is nothing to pull against on the outside or on the inside.

If it is a simple fracture of the external malleolus, then strong inversion of the foot with the foot at right angles and fixation in a

cast in this position is all the treatment that is necessary, and good results can be expected if this is followed. Where both bones are broken it is the opinion of the authors, based on experience with many cases of this kind, that at least one malleolus should be fixed, preferably the internal malleolus, with a single ivory nail driven longitudinally through the internal malleolus and into the tibia. Then we have to deal only with the external malleolus which can be pulled into position by strong inversion of the foot. The fixation of this bone in this way is an extremely simple procedure if the surgeon is equipped with proper instruments and hospital and surgical technic. It, of course, involves the opening of a joint and extreme care in asepsis must be observed. The incision also must be placed so that the scar does not come immediately over the bone for two reasons: First, ease of infection; second, adhesion of the scar to the bone, which makes a painful scar.

This case illustrates two conditions: Lack of proper treatment at time of injury and, more important, lack of proper diagnosis of the pain in left ankle after being released from treatment following injury. Consequently, over a year after the original injury the diagnosis of ununited fracture of the internal malleolus was made and the proper treatment given.

Thus the patient lost nine months of his time, and this meant a loss to him over his compensation of $30 per week, or a total loss of over a thousand dollars.

The insurance company lost nine months' compensation and paid a large amount of money for surgical treatment that did not yield them anything.

EFFORT SYNDROME, WITH POLYCYTHÆMIA PRODUCED BY RAPID
SHALLOW BREATHING

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A., male, aged twenty-seven years. Miner. Italian subject, single, resident of the United States nine years.

History.—September 8, 1919, the patient was trying to lift a large piece of coal over the side of a coal car. The lump of coal broke in two parts; one of the pieces, falling on the outside of the car, struck the patient on the chest.

Fig. 4.

X-ray (Dr. H. E. Potter) shows good bony union of fracture of outer malleolus. Internal malleolus ununited fracture and displaced outward along with the astragalus.

Fig. 5.

X-ray (Dr. G. C. Briggs) shows ivory nail holding internal malleolus with good callus formation.

Fig. 6.
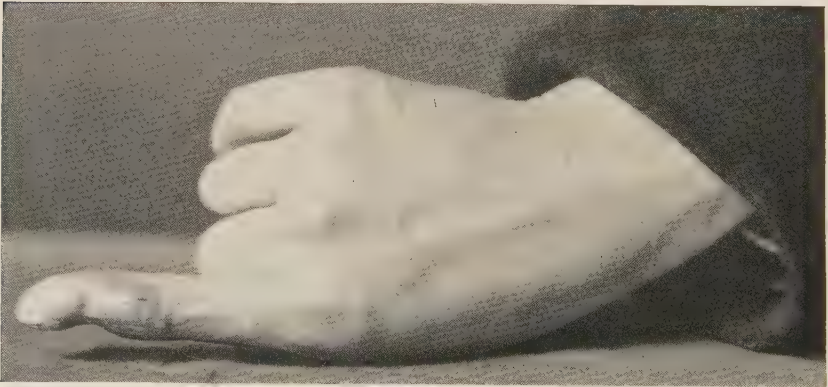
Case A. R. shows index finger, right hand, with distal joint entirely rigid. Scar runs from middle joint to distal end of finger, is tightly adherent to the bone and is painful.

Fig. 7.

X-ray (Dr. H. E. Potter).   Case R. B.   Antero-posterior view, shows a fracture of the 3rd lumbar vertebra in which the body is compressed and a large amount of callus has grown around all the margins, tending to lock it with the adjacent vertebra.

FIG. 8.

X-ray (Dr. H. E. Potter). Case R. B. Lateral view, shows compression fractures of the twelfth dorsal and third lumbar vertebræ.

Following the injury he complained of pain in the left chest; only, however, at such times as the heart rate was unusually rapid; of soreness of chest muscles; of dyspnœa on exertion; and insomnia. He has not worked since and claims total disability, because of the pain and dyspnœa. The record of the examination by the Company physician is not available. According to the patient he was admitted to a hospital in Murphysboro, Illinois, and was discharged after twenty days, unimproved.

Previous personal history is to the effect that prior to the accident he had for some time complained of the oppressive air of the mine. He also had smothering attacks and suffered from anorexia. Denies alcoholism, venereal and all other diseases. Family history negative.

Examination (February 21, 1920.—Five and one-half months after injury). *General:* Well built, slender and muscular young man. Normal distribution and amount of adipose tissue. There are no skeletal abnormalities or deformities. There are no cutaneous scars or other evidence of physical injury. Skin has normal dark hue of the Latin races, but in addition, it gives one the impression of being hyperæmic. The lobes of the ears attract attention because of redness. The skin is quite moist and perspiration may be seen dripping from the axillæ. The finger nails are slightly cyanotic, but are otherwise normal. General attitude is one of fear and apprehension. The movements of the examiner are closely followed and frequent reassurance is necessary.

Eyes: Conjunctivæ injected. Iris brown. Pupils normal in size, shape and reaction to light and accommodation. Cilio-spinal reflex normal. Ophthalmoscopic examination negative except that the retina is highly colored and the vessels have a darker hue than normal. Extrinsic muscles normal. No Von Græfe, Stellwag or exophthalmos. *Nose:* Negative. *Tongue:* Negative. *Teeth:* Poorly cared for. Severe purulent gingivitis. *Pharynx:* Negative. *Neck:* Thyroid not palpable. No adenopathy.

Chest: No tenderness. No evidence of rib fracture. The chest is of normal shape. Respiratory movements are very shallow. Both sides of the chest move symmetrically. Respiratory rate varies. While the chest was being examined the rate was 38. Later, while carrying on a conversation, the rate dropped to 18. Costal type of breathing. Fremitus and resonance are normal. Impossible to determine excursion at the base because of limited chest movement. Auscultation shows the breath sounds to be much shortened, and audible only over the large bronchi. No râles.

Heart: Normal in size, shape and position. Rate while seated 100. Rhythm regular. Tones loud and clear. Aortic 2nd plus. No murmurs. Rate increased to 130 by 15 seconds' exercise.

Vessels: Carotid pulsation visible. Aorta cannot be palpated. Retrosternal dulness not increased. Brachials and radials soft and compressible. Systolic pressure 140, diastolic 90.

Blood: Erythrocytes, 7,064,000; morphology normal; Hemoglobin (Dare), 100 per cent; Color Index, .71; Leucocytes, 5400, normal relations; Wassermann, test negative.

Urine: Negative.

Nervous System: Negative, except for an area of hyperæsthesia corresponding to the area of cardiac dulness, and marked exaggeration of all super-

ficial and deep reflexes. No pathological reflexes. No tremor. Muscular power on both sides of the body equal. Exhaustion readily produced.

The patient was admitted to Wesley Memorial Hospital for further study on April 6, 1920 (seven months subsequent to the injury).

Re-examination gave practically the same findings. Erythrocytes, 6,888,000. Basal Metabolism rate 33.1 per cent. above normal (Benedict Method).

Röntgen Examination.—No evidence of physical injury or disease of the chest, lungs, heart or diaphragm was found.

During the fluoroscopic examination of the chest it was noted that the respiratory rate was greatly increased and that the excursion of the diaphragm did not exceed one-half inch. After the administration of a bismuth meal the attention of the patient was diverted from his chest. It was then noted that the respiratory rate fell to normal and that the diaphragm had an excursion of at least two inches on both sides.

Summary.—Increased respiratory rate. Decreased respiratory excursion. Slight cyanosis. Congestion of the skin. Polycythæmia. Hypertension. Tachycardia. Increased metabolic rate. Exaggerated reflexes—apprehensive attitude. Hyperæsthesia over heart.

Diagnosis.—Effort syndrome.

Discussion.—The case is of unusual clinical interest as well as of more than ordinary interest in relation to industrial medicine.

Here is an organically sound young foreigner, aged twenty-seven years, with an emotionally unstable neurotic make-up, who, following a minor injury, is incapacitated for his former vocation because of a functional breakdown. He has not worked for seven months. He is not a malingerer in the ordinary sense of the word, and yet he feels that he is entitled to compensation because of an injury to his chest, so slight in degree that it failed to bruise the skin. Prior to the accident he complained of the oppressive air of the mine, had smothering sensations and suffered from anoræxia. A more intimate acquaintance with his previous history would doubtless show other evidences of a neurotic constitution. In this connection it is worthy of note that he applied for and received exemption from military service, not on the grounds of ill health, but on the ground that he was not a citizen of this country   To me, this is significant of a pre-existing fear and apprehension which is at present well developed.

It cannot be stated that the accident did not aggravate his condi-
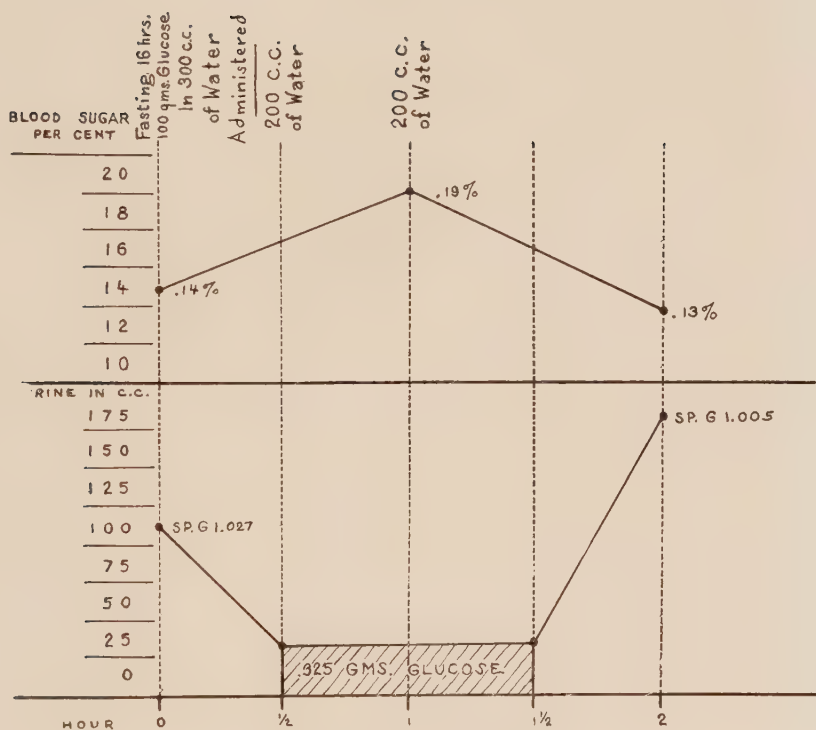
Glucose tolerance and utilization test.

tion, even though it did not initiate it. He probably did have pain in the chest following the injury which soon assumed a position of so much importance as to furnish him with a satisfactory explanation of all his symptoms. Hence, the request for compensation and the refusal to work until it had been received and spent. To this extent he is a malingerer, as all neurotics are.

Just what type of functional disturbance incapacitates him? The tachycardia, sweating, increased metabolic rate, insomnia, etc., suggest Graves's disease. Were these symptoms, however, the result of a hyperthyroidism of seven or more months' duration, one would expect to see some of the classical signs of this disease, such as Graefe or Stellwag sign, exophthalmos, emaciation, palpable thyroid, bruit, tremor, etc. None of these signs are present. Their absence does not, of course, exclude hyperthyroidism, but makes it less probable.

During the recent war thousands of cases with a symptomatology very similar to the one under discussion were observed in all armies. They were designated by the term " effort syndrome " by some, and by others as " disordered action of the heart." The condition is regarded as being a functional disturbance arising in a constitutionally inferior individual. In a fairly large number of cases the acute symptoms disappear under treatment by physical reëducation. The constitutional predisposition cannot be removed, however, and subsequent attacks are likely to occur if the patient is exposed to the proper stimuli. There is a very great probability that many of these cases are either caused by or associated with some endocrine gland disturbance with the thyroid and dorso-lumbar sympathetic nervous system playing a dominant part.

What caused the polycythæmia?

Haldane, Meakins and Priestly have recently called attention to the harmful effects of rapid, shallow breathing in the production of anoxæmia. Although in this type of rapid breathing the minute volume of tidal air may be normal or above normal, the volume per respiration may be so far below normal as to do little more than fill the pulmonary dead space. Insufficient expansion of the pulmonary alveoli thus leads to deficient absorption of oxygen. The production of a polycythæmia is a defense against anoxæmia, the result of persistent difficulty in the proper aëration of the blood. The compensation in

this case is perfect when the patient is asleep and when he is not conscious of his heart and respiratory action.

This fact having been established, the patient was told that his only hope of recovery lay in the gradual resumption of physical activity. He was assured of a sympathetic hearing by the Industrial Commission. With this assurance he expressed a desire to return to work, providing he could receive compensation for the time lost.

The institution of graduated exercises was indicated, but, unfortunately, the facilities of the hospital did not permit of this form of treatment. He was, therefore, discharged, with a diagnosis of "effort syndrome," with the recommendation that compensation, if allowed, should be in the form of a cash settlement.

CONSERVATIVE (?) TREATMENT OF CRUSHING INJURY TO FINGERS

A. R., aged thirty years. Examined on April 12, 1920.

History of Present Condition.—Patient states that on December 23, 1919, he received a crushing injury to the index finger of the right hand, in a punch press. The thumb side of the distal joint was gouged out and the external surface of the finger lacerated from the middle joint to the tip. The middle joint was not involved. The wound was iodized and dressed with dry dressings and has been healed completely only within the last ten days.

Examination.—At the present time examination shows the distal joint is entirely rigid, what appears to be, without an X-ray examination, bony ankylosis. There is a rough surface over the posterior part of the middle phalanx, which is covered with scar tissue, and a scar running from the middle joint to the distal end of the finger. There is 60 degrees of motion in the middle joint, the scar on the side of the finger is tightly adherent to the bone and he says it gives him pain when he strikes it against any hard surface (Illustration Fig. 6). Consequently, he cannot work at this time, and amputation at distal joint was advised and the man agreed to it.

Comments.—It might be pointed out that a loss of this kind in the case of a finger injury on account of the so-called conservative treatment of these injuries, is one of the most frequent things that comes to our attention at the Industrial Commission. There should be a very clear line of difference shown between conservative treatment where there is a chance to save a member which will be useful to the patient and the saving of a member which, when saved, will be absolutely useless. It is folly to save anything which will not only be of no use to the individual, but will actually be in the way of the performance of his duties, and some Commissions would hold that a painful member, instead of being loss of use only of a part of the

member, such as a finger, would constitute a partial loss of the hand until such time as the finger were properly amputated.

Statement of Financial Loss by this Treatment.—This patient had an injury to the finger which has disabled him from work for ten weeks.

Patient's earning capacity per week $30.00	
Ten weeks' loss of time	$300.00
Cost to company in compensation	120.00
Cost of medical service	75.00
Loss of finger—50 per cent.	205.00
Total cost to date	$700.00
Future amputation of finger at distal joint, including subsequent dressings	75.00
Hospital bill	10.00
Further loss in earning, 3 weeks @ $30.00	90.00
Further loss in compensation, 3 weeks @ $12.00	36.00
Total loss for half a finger	$881.00

This should have been, if proper surgical judgment had been accepted and amputation done at the proper site at time of injury:

Loss of use of finger—50 per cent.	$205.00
Hospital bill	10.00
Compensation	36.00
Operation and treatment	75.00
Loss in earnings to the amount of	90.00
Total	$416.00

A difference of $475 loss to all concerned by improper surgical treatment.

COMPRESSION FRACTURE OF THE SPINE, COMPLICATED BY MANY THINGS

R. B., age sixty-eight years. Examined May 24, 1920.

History of Present Condition.—It appears that on July 30, 1919, this patient was stooping over in a coal mine when a lump of coal, which he estimated at about five hundred pounds in weight, fell from the roof, striking him on the back at about the level of the shoulders. This forced him into a position of acute flexion. Since, he has pain in the lumbar and sacral region and in the left foot. He says that after the injury his ankle and foot were discolored and swollen and that the treatment for all this trouble was " watchful expectancy " with advice to rest.

Examination.—Examination shows a flat lumbar spine, the second, third, fourth and fifth lumbar vertebræ being prominent. There is a great deal of tenderness over the sacro-iliac joints. The lumbar muscles are in spasm and stand out tense and hard. Lateral motions are not present. On forward flexion there is no movement in the spine, it occurring entirely at the hips. Support over the back gives relief; lifting the weight of the body by the examiner's arms under the patient's elbows, gives marked relief.

The left ankle is slightly swollen and tender, especially over the scaphoid on the inner side of the foot. There is a marked relaxation of the plantar fascia and the internal lateral ligaments and pronation of the foot.

Examination of the mouth shows seven snags of teeth from around which pus can be squeezed. The throat and tonsils are not inflamed. Nose and accessory sinuses are normal.

Patient says he is chronically constipated and the laboratory report shows that there is a trace of albumin and a trace of sugar in the urine and a large excess of indican, a few hyaline and granular casts. The Wassermann is negative. The white count is 13,000 and the red count and hæmoglobin normal.

X-ray examination by Dr. Hollis E. Potter shows in the antero-posterior view a fracture of the third lumbar vertebra in which the body is compressed and a large amount of callus has grown around all the margins, tending to lock it with the adjacent vertebræ (see Fig. 7). The sacro-iliac gives an appearance which would indicate a chronic inflammatory process which may be due partially to an injury and partially to an infection. On lateral view of the lumbar spine, the third lumbar and twelfth dorsal show fractures of the compression type (see Fig. 8).

X-rays of the left ankle demonstrate there is a slight irregularity in both external and internal malleolii which probably evidence a healed Pott's fracture with very little displacement. The arteries of the foot, as well as in the pelvis, show pronounced sclerosis, and this was borne out by physical examination.

Treatment.—In a patient of this age, who is on the shady side of the hill, it is impossible to do anything except give relief. This was done for the left foot by giving support to the foot and ankle, which the relaxed ligaments did not support by an eight of an inch "dutch-

man," which is a wedge of leather, placed on the inner margin of the sole and heel of the shoe. This throws the weight of the body on the outside of the foot and somewhat inverts it. A felt pad on a soft leather insole was placed under the arch of the foot, between the sole of the shoe and the sole of the foot, to give additional soft and yielding support to the instep. This gave great relief, according to the patient, and he was able to walk without a limp immediately.

Treatment of the back injury was a combination Taylor spine brace with Goldthwait belt to take the strain from the lumbar muscles and further strengthen the pelvic girdle.

Patient was placed on a vegetable, fish and chicken diet, restricted on sugar and starches, a gallon of water a day prescribed, in doses of one glass at regular intervals, and a purge and sweat once a week. The results of the treatment have been eminently satisfactory, so far as the patient is concerned, but, as heretofore stated, in a man of sixty-eight with this sort of injury, one cannot effect a cure, but only give relief, which seems to have been accomplished by these methods.

ENCEPHALITIS EPIDEMICA

By Ralph C. Hamill, M. D.,

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E. R., aged forty-six years. Coal miner.

History of Present Condition.—He stated that three months previously he had been struck on the top of the head by a stone, about the size of his fist, falling three or four feet. He did not stop work. A swelling half the size of a hen's egg developed at the site of injury. He continued to work for the next three days. At about ten o'clock on the night of the fourth day he was awakened by a very severe pain running through the right side of his head down the back of the neck and into his right shoulder. He could get no relief from this pain, which lasted two days and nights, preventing sleep. At the end of this time, "it drove me out of my head." He apparently was delirious for three weeks, two of which were spent in a hospital. The symptoms of vertigo, weakness, etc., were present when he emerged from his delirium.

Came to hospital in March, 1920, where he was under observation for nine days. At the time of entrance he complained of continuous vertigo, tenderness and soreness at the back of the head, weakness and spasmodic, somewhat painful jerkings of the muscles in the left side of the abdomen. When first seen by me the characteristic thing about the disease picture was a certain fixity of expression, a more or less mask-like face and a rhythmical twitching of the sterno-cleido-mastoid, the cervical erector spinæ and the trapezius muscles. He was entirely unconscious of these twitchings.

Examination.—Examination showed normal cranial nerves, save that fixing his vision on a rapidly moving finger for a few moments produced a suggestion of unsteadiness or nystagmoid movements, especially as he moved the eyes to the left. Plantar reflexes normal. Tendon reflexes normal. Cremasteric and abdominal reflexes diminished. It was observed that during sleep, the twitchings of the neck muscles were of decidedly greater amplitude than during his waking hours. Wassermann reactions were negative. The urine and blood were negative.

Comment.—This case came to my observation just after I had seen three other cases of almost identical clinical pictures, cases setting in with severe pain about the head or neck, the pain lasting for two or three days to a week, fever developing after two or three days, delirium for one to three or four weeks and rhythmical twitchings of the muscles ordinarily used in forced respiration.

The fact that the original injury did not even cause him to stop work on the day received, that it was due to a force of no great moment, a fist-size piece of stone falling two or three feet, makes it extremely improbable that the accident played more than a very minor rôle in the causation of his disabling sickness. To be sure, it is possible that the injury acted as a producer of a locus minoris resistentiæ.

In commenting on the cause of encephalitis in the Australian epidemic of 1917, some authors state that exposure to the sun, and head injuries, may predispose to a localizing of an infectious virus in the brain, a virus which, in the presence of a great epidemic, is doubtless existent in the blood of a great number of people. In some such sense as this it may be that the blow on the head really plays a part in the disease picture with which we are concerned; otherwise, it is merely to be regarded as a coincidence. It happened that this particular man got well. If, on the other hand, he had died and no post-mortem competently followed up by microscopic examination of the brain had been performed, it probably would have been diagnosed as a hemorrhage developing late after injury.

NOTE.—Has already been described in the Archives of Neurology and Psychiatry.

FRACTURE OF THE FIFTH LUMBAR VERTEBRA WITH INJURY TO THE CAUDA EQUINA

R. H., aged forty-four. Coal miner.

History of Present Condition.—In October, 1919, the patient was working in a coal mine, was leaning over when a mass of rock, falling four or five feet,

struck him on the back, the exact spot is not known. He was unconscious for a few moments only; was unable to move his legs; had retention of urine, but felt little or no pain until three or four days after the accident. Then the pain appeared and ever since has been one of the most distressing features of the case.

When first seen, early in May, 1920, he was suffering from complete paralysis of the feet and legs up to the level of the quadriceps femoris and sartorius. He had a tremendous bed sore over the sacrum and another over the right great trochanter. The feet were badly deformed, ankylosed in most of their joints in the position of extreme extension that appears in feet flaccidly paralyzed that are subjected to the weight of bed clothes. There was extreme wasting of the peroneal and calf muscle groups. Movement of the knees was possible through only about ten or fifteen degrees. Sensation was abolished over the feet, lower legs, backs of thighs and sacral region; the genitals were analgesic. The line of analgesia followed in a general way, the distribution of the upper level of the fourth lumbar roots. The anal sphincter was completely relaxed; there was more or less constant expulsion of fecal matter; desire to urinate was sensed as a burning in the suprapubic region, but there was neither knowledge nor control, of micturition.

The large decubitus ulcer over the sacrum prevented examination of the spine, but any attempts to move the trunk brought on a complaint of pain in the lower lumbar region and in the legs. The X-ray plates bore out the suspicion that these pains were due to fracture of the lower lumbar spine, revealing a crushing of the body and laminæ of the fifth lumbar vertebra. In general appearance the man was septicæmic.

Any one who has seen the deformed, ankylosed joints of the legs of a case of flaccid paralysis knows what a pitiful picture it is. When it is complicated, as so frequently happens, by more or less constant expulsion of bowel and bladder contents, by decubitus ulcers, by general septicæmia, due in most cases to the combined malign influences of infections of the urinary tract and absorption of poisons from the decubitus ulcers, a picture of neglect and mistake is presented that is not to be excelled in any branch of medicine.

Treatment.—It will take a long time to clean up the decubitus ulcers and until they are cleaned up it will be impossible to relieve the pressure on the cauda equina. It may then be too late, or the patient may succumb from a sudden lighting up of the urinary infection. At any rate, if pressure on the cauda equina is relieved by operation, it will be a long time before the disability, due to the deformed, ankylosed joints, can be overcome.

The care of the case at present is quite different from that indicated in a recent uncomplicated case of fracture of the fifth lumbar vertebra. The indications now are to build up the patient, aid in

the healing of the decubitus ulcers and then consider operation on the spinal contents.

Every hospital handling accident cases must have an air or water mattress to equalize pressure. The patient must be put on such a mattress. The ulcers must be treated with such antisepsis as seems indicated, occasional irrigation with Dakin solutions, etc.

The very distressing dribbling of urine can be improved by daily irrigations of the bladder, care being taken not to overdistend the bladder wall. It is possible that an "automatic bladder" may be established if the wall has not been too much affected by infection. In a recent number of the British neurological journal, *Brain,* the subject of the "automatic bladder" is very thoroughly discussed. Patients can be taught to empty their bladders automatically, though they have no real voluntary control in the ordinary sense.

The patient must have a flushing of the colon every day.

He must never be moved unless it is imperative.

If this case had been recognized immediately, and it is difficult to see why it should not have been recognized, if even proper X-ray examination had been made, operation could have been performed, pressure on the cauda quina relieved and a large proportion of function preserved. In fact, it is possible that a negligible amount of disability would have remained.

Comment.—"The principal thing is to find out what is the matter with a man and then anybody can treat him."

This statement, made by a doctor delivering the graduation address to my class at the end of my medical school course, has always stuck in my mind; and it is only after considerable experience with industrial cases and in work with the ex-service men that I have realized the full significance and truth of the remark. "Find out what is the matter with a man" means, of course, not only the injury or disease that a man has become subject to, but it also means the man's reaction to the forces that threaten his disability. In other words, the medical problems, especially in cases of industrial disease or accident, must include, besides the actual physical damage, the state of mind, the mental reaction of the individual sustaining the disease or injury. Medical men are universally familiar with the phrase from the mouth of the patient, "Oh, the pain isn't so bad, I could stand that, but it's there all the time"; or, "But I can't

understand what it may mean "; or, " That first doctor that took care of me, he said I could go back to work in a couple of days "; or " He didn't give me a thorough examination," etc., etc. Expressions of the belief on the part of the patient that he has suffered from some disabling cause, the full effects and consequences of which are unknown to him, and *the doctor to whom he has gone has in some way revealed to the patient either his inability or his unwillingness to find out what is the matter.*

So long as the laboring public realizes this lack on the part of the medical public, just so long is it going to persist in its attempts to secure damages whenever any excuse whatsoever presents itself. If mistakes are made by the doctor in cases where there is actual physical damage, certainly it is possible that the doctor may make a mistake and believe that feigned injury is real. Such an idea in the minds of the laboring public is bound to play its part in this flood of traumatic neurosis that companies, insurance companies, industrial commissions, etc., are constantly battling. Rumor in the mouths of the ignorant, the uninstructed, makes full use of any chance that mistakes on the part of the so-called educated, the instructed or medical public, may make. We are all of us conscious of the fact that suspicion exists in the minds of the laboring public of the motives of the employing class, and regards the medical men in the employing class. So when errors are made by the doctors who, in the eyes of the laboring class, are all-wise, those errors are bound to be thought of not as the ordinary mistakes of the fallible man, but rather as the dishonest, intentional attempt to prevent the injured laborer from getting a square deal.

Hence, an error made in an industrial community, by the doctor who is employed by the company, carries with it a certain amount of proof to the minds of the laboring public of that doctor's dishonesty, no matter what his real integrity may be. Of course, physicians are going to make mistakes to the end of time, but it is only just that attempts be made to cut down the number of these mistakes as much as possible. Unquestionably, one of the points of friction between capital and labor lies in the fact that the laboring man is unable to employ the high class of medical talent that capital can command, and it is the duty of capital to appreciate the force of this and to employ for the care of its employees a high class of medical talent

and thus minimize the number of mistakes made by its medical men as much as possible.

The two cases just described are examples of mistakes, the importance of which certainly goes far beyond the effect on the single individual obviously involved. In the first case, a disease belonging in an epidemic, followed soon after a minor accident. The patient believed, and probably all his friends agreed with him, that the sickness was a direct consequence of the accident. When it is generally known that instead of getting damages for the accident, he is told that the accident had nothing or very little to do with his period of disability, he is bound to be suspicious of the motives, not only of his first physician, who allowed the disease to escape detection, but also of the physician who made the final diagnosis. The second case is one in which correct diagnosis would have led to early operation and proper restoration of function with little permanent disability.

FORWARD DISLOCATION OF SEMILUNAR BONE; UNDIAGNOSED

C. A., aged fifty-eight. Laborer.

History of Present Condition.—This patient, on September 6, 1919, was opening a heavy gate, his right arm was flexed at the elbow; the hand midway between pronation and supination, had hold of the swinging end of the gate by its edge. The gate was forced back suddenly, the elbow striking a beam and the hand forced into hyperextension. He had immediate and severe pain with swelling in the wrist, especially on the flexor surface. Loss of flexion of the wrist was immediate and permanent. The extension was not so much interfered with, although the swelling was severe for about a week, after which time it subsided under hot applications and massage by the patient. He says there has always been a sore spot in the flexor surface of the wrist, immediately distal to the anterior lower margin of the radius where it articulates with the ulna.

Examination (April 12, 1920).—Pronation and supination are normal. Extension is normal. Flexion is only 10 per cent. of normal. (See Fig. No. 9.) When flexion is forced, he complains of severe pain in the extensor surface of the wrist over the carpus. On sudden flexion, a sharp, quick blocking of the joint is felt as though one were trying to close a door with something protruding into the flanges of the hinge. There is pain elicited on pressure over the mid-anterior surface of the wrist just distal to the lower end of the radius at the radio-ulnar articulation, and there is a bulging at this joint (see Fig. No. 10) which can be felt with a corresponding depression on the extensor surface immediately opposite, into which the finger can be forced. (See Figs. No. 11 and 12.)

Mechanism.—The normal angle of the wrist-joint, looking from the side, slopes slightly downward and forward. The posterior lip of the lower end of the radius is longer than the anterior lip. The

FIG.9.

Full amount of flexion in both wrists. Case of dislocation of semilunar bone.

FIG. 10.
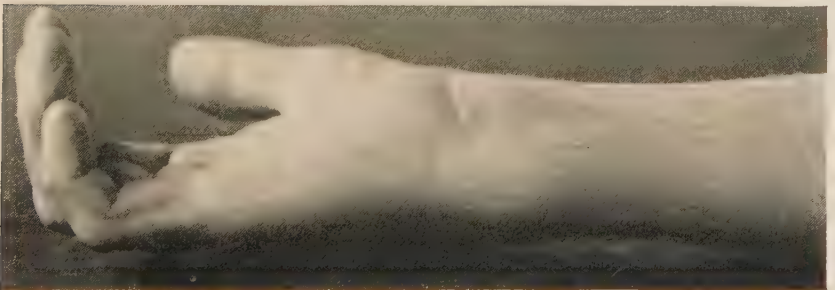
Dislocation of semilunar bone. Note bulging at anterior surface at lower end of radius.

FIG. 11.

X-ray (Dr. H. E. Potter). Dislocation of semilunar bone. Lateral view shows displacement of semilunar anteriorly and clear space between unciform and lower end of radius.

FIG. 12.
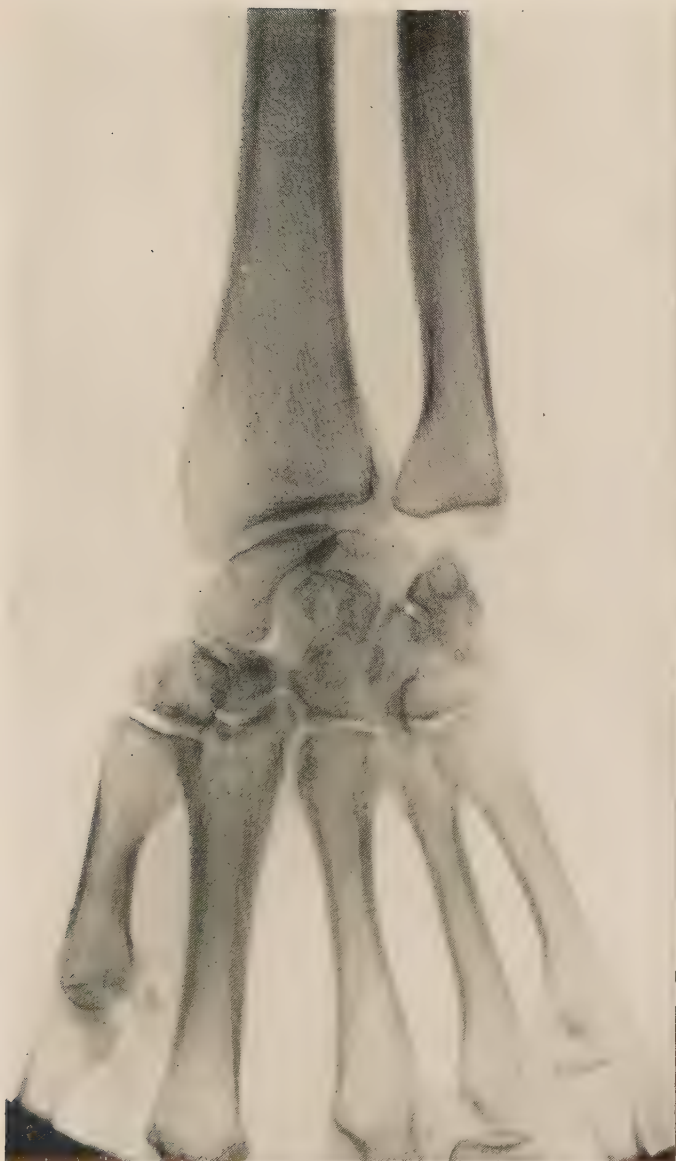
X-ray (Dr. H. E. Potter). Dislocation of semilunar bone. Antero-posterior view shows space left by pushing forward of semilunar. This is one of the most important features in the diagnosis of this condition.

hand coming into hyperextension, the posterior or dorsal part of the semilunar bone comes in contact with the posterior lip of the radius and is forced downward and forward by the wedge-like pressure of the posterior lip of the radius against the semilunar in back. If the carpus could slip away from the lower end of the radius, this would not occur, but the flexor tendons of the hand and the anterior capsule of the wrist-joint do not permit this; consequently, the semilunar is driven forward in the same axis in which it lies. It then remains displaced with the concave surface of the semilunar toward the palmar surface of the hand. This having occurred, the semilunar prevents immediately and permanently, as long as it lies in this position, any flexion of the wrist-joint, because this bone acts as a wedge driven between the anterior lip of the lower end of the radius and the hook on the unciform and the os magnum, and absolutely prevents flexion beyond ten degrees.

Practical Anatomy.—The anterior capsular ligament of the wrist-joint is greater in strength than the posterior and is reinforced by the flexor tendons which are larger in number and greater in strength than the extensor tendons. Consequently, when the hand is brought into hyperextension, there can be no slipping away of the carpus from the posterior lip of the radius which would produce an anterior dislocation of the wrist and one of two things may happen—a Colles' fracture or a dislocation of the semilunar bone anteriorly, which may or may not be complicated by a fracture of the scaphoid. There are several factors which enter into the production of these various injuries. The position of the hand in Colles' fracture is usually a full pronation and happens with a sudden, sharp impact, which results in a direct force violently applied, which produces, according to James H. Stevens ("Compression Fractures of the Lower End of the Radius," *Annals of Surgery,* May, 1920, Vol. 71–5), a disintegration of the cancellous bone at the point of greatest weakness in the line of force, which is usually the lower end of the radius, very near to the wrist-joint. These lines of fracture vary, depending on the line of force and the violence of the force applied (Louis S. Pilcher, "Fractures of the Lower Extremity or Base of the Radius," Lippincott). If the hand is midway between the pronation and supination and the force is a more gradual impact which applies a stretching rather than a sudden breaking force, the bone withstands the blow and does

not shatter. When the hand comes into complete extension, the semi-lunar impinging against the posterior lip of the radius, it is the ligaments which support this bone which give way and the bone is forced out of its place far enough to allow the hand to come into hyper-extension. This allows room in the posterior carpus for the posterior lip of the radius. To complicate this injury further, the median nerve, which runs under the anterior annular ligament about midway between the styloid process of the ulna and the tip of the radius, is sometimes pressed upon by the dislocated semilunar. This gives a tingling sensation in the hand, sometimes anæsthesia over the area supplied by the median, and always great tenderness on the flexor surface of the wrist.

Comments.—This patient was injured on September 6, 1919; he was examined on April 12, 1920. During this time it had not been recognized that he had a dislocation of the semilunar bone. The patient had been given massage and forcible flexion until the capsular ligament of the wrist-joint was so traumatized that the patient not only had extreme pain on pressure on the anterior capsule, but no doubt many torn fibres in the posterior capsule from an attempt to force flexion in a joint where a bone was actually blocking the movement in that joint. Flexion of the wrist in this condition is just as impossible to obtain as the shutting of a door if a crow bar were forced between the surfaces of the hinge.

There have been seven months' disability in this case, about two hundred dollars spent for massage which had done the patient great harm instead of decreasing the disability, and the patient now has 75 per cent. loss of use of the arm because of the pain produced upon any motion of the wrist.

Treatment.—It may be possible to force this bone back into place if the injury is recognized within fifteen minutes to an hour after it occurs. To do this the wrist is hyperextended and pressure put on the anterior surface of the bone to force it back while the wrist is extended and the position held while the wrist is flexed. The authors have never come in contact with one of these which it was possible to reduce in this way, and do not believe that this reduction can be effected except in extremely early cases, since it takes a very short time for the space to fill up and adhesions form, which will prevent manipulation of this bone.

Removal of the bone, however, gives extremely satisfactory results, if done with proper skill and care. It must be remembered that the bone lies immediately under the median nerve and immediately under a very important bundle of flexor tendons, damage to either of which will give a very serious disability of the hand. These must be carefully handled and held by smooth retractors while the bone is exposed and when exposed this bone should be carefully dissected out with a very thin bladed scalpel. The operator should stay close to the bone, being careful not to inflict any injury whatsoever on the surrounding structures. The authors have seen one case in which an inexperienced operator attempted to remove the semilunar, when called to his attention after having treated the case eight months as a sprain of the wrist. When examined on the second occasion, the semilunar had been removed, but the patient had a large burn on the index and middle fingers which he was not aware of, on account of the anæsthesia produced by the cutting of the median nerve.

Summary.—In dollars and cents this injury should have cost about six weeks' disability, with no permanent loss of use of the arm. As a matter of fact, it has already cost seven months' disability, with about two hundred dollars for massage treatments, one hundred and fifty dollars for medical and hospital bills. There is a 75 per cent. disability of the arm remaining; it will be necessary to operate, which will cost at least two hundred dollars more, after which it will be necessary to give massage treatments over a course of from two to three months, further extending the disability to about twelve months and then leaving probably about a 15 per cent. disability of the arm.

FOCAL INFECTION COMPLICATING BACK INJURY

J. D., aged fifty-one. Miner.

History of Present Condition.—On July 8, 1918, this man was standing in a somewhat stooped position when a fall of coal from the top of the mine struck him on the shoulders, doubling him up and finally throwing him over on his right side, with a twisting motion. He had acute pain, especially located in the right sacro-iliac joint, which prevented him from hyper-extending his leg. He had less acute pain in the lower dorsal and lumbar region. He was not confined to bed for any great length of time. He manged to get around the house and out of doors a little, but has had continual pain in the lower dorsal and lumbar region and right sacro-iliac region ever since this time. It is now a year and a half since the injury. He has done no work and says that his back is getting worse instead of better.

Examination (January 16, 1920).—Patient stands with a slight stoop with rather an acute bend in the spine at the level of the seventh, eighth and ninth dorsal vertebræ. Complains of pain under the twelfth rib in the lower dorsal and lumbar region and sharp pain over the right sacro-iliac and into the gluteal region of the right side. Lateral motion to either side shows a segment of rigidity around the seventh, eighth and ninth dorsal, which is also seen in forward flexion. Pressure downward on the shoulders elicits pain, especially in the lower dorsal region. Lifting the patient by his elbows with his arms flexed, he says, gives him relief. Slight hyperextension with pressure over the lumbar and sacral region, he says, gives him relief. Says that at times his body feels too heavy, as though it were going to fall forward.

X-ray examination by Dr. Hollis E. Potter shows no pathology of any kind in the spine.

Examination of the teeth shows well-advanced stage of pyorrhœa in all the upper and two of the lower teeth. Examination of the accessory sinuses shows no infection. Tonsils were normal.

Treatment.—Within a few days after the examination all of the upper teeth were extracted and the two lower ones showing infection. Patient was fitted with a combination Taylor spine brace and Goldthwait belt. This gives girdle support to the pelvis, holding the sacro-iliac joints and also vertical support to the spine, preventing flexion. On the way to the bracemaker's to be fitted, some two weeks after patient was examined, he says he was standing in a street car, holding on to a strap when the car struck a curve at a rather rapid rate; the motorman threw on the brakes rather quickly, and it threw him with a twisting and hyperextension motion rather suddenly into a position of hyperextension, of the right leg with lumbar spine. He says he felt something snap and that the pain in the sacro-iliac region immediately disappeared and he has not had a return of it to this date, some six months later. This motion, however, gave him greater pain in the lower dorsal and lumbar region. After the brace was fitted, electric dry heat was applied daily for half an hour, followed by massage of the lumbar and dorsal muscles.

In about four weeks from date of examination, patient volunteered the information that the pain in his back was very much improved and after eight weeks' treatment requested permission to return home and do light work. He said that he had no pain in his back

unless he stooped over to lift something, and then he had no sharp pain, but felt that his back was weak. He was given a system of exercises, involving mild lateral flexion, forward flexion and rotation of the spine, to be gradually increased as his strength and ability to perform the exercises increased. The exercises which were prescribed were simply to bring back the strength of the muscles controlling the spinal movements.

Comments.—This is a case of slight displacement of the sacro-iliac joint, probably due to traumatism, in conjunction with a condition of poor tone of the ligaments supporting this joint on account of this infection. It is generally agreed that under normal conditions the sacro-iliac joint is an immovable joint, but under conditions of overstrain, infection or toxæmia, that these ligaments lose to a certain extent their tone and allow a certain amount of motion, as they do in a normal pregnancy. A strain applied at a time when the ligaments are below par in their ability to hold weight will cause a slight slipping of the joint, which puts just enough tension on the already sore and overstrained ligaments to give acute pain. When this occurs, it amounts to exactly the same thing as an overstrain or wrench of any other joint where there is a subluxation. The main condition being that the patient cannot assume the upright position without throwing strain on the sacro-iliac by the very nature of its location and position. Because it is covered by heavy muscles and ligaments and because the X-ray does not show pathology, in many cases, it has been assumed by the medical profession as a whole, at least until very recently, that there could be no injury to this joint. Whereas, those who have worked especially with backs, realize that these joints are subject to the same strains and diseases to which other joints are subject. They also recognize that many patients in which X-rays do not show pathology have exactly the same strain of the ligaments as those where the X-rays do show pathology in the relation of the bones of the sacro-iliac region. It is our opinion that this sudden relief of pain by the twist and hyperextension that this man received simply replaced a subluxation of this joint which had occurred at the time of the injury and which had persisted since that time.

The fact that the patient's teeth were badly infected and that the condition cleared up with a great deal of promptness after the infection had been removed shows clearly after a year and a half of

disability that this man was suffering from an arthritis of the articular
facets, especially the lower dorsal and upper lumbar region.   All
cases of injury to bones, joints, tendons and ligaments, and all cases
where operation is contemplated on bones, joints, tendons and liga-
ments before they are operated are carefully examined in our clinic
for infection of the teeth, tonsils, nose, accessory sinuses and prostate.
A urinalysis is made which always includes a test for excess indican
to determine the possibility of a chronic intestinal toxæmia.   The
prostate is massaged for a latent gonorrhœal infection and a Wasser-
mann is made as well as a complete blood count.   These steps are
somewhat expensive, it is true, but it will be found that when dealing
with cases that may become serious as a result of these conditions
that the primary expense of this sort of an examination saves many
more dollars than it costs in preventing disabilities occurring and
being prolonged.

ACROMIO-CLAVICULAR DISLOCATION

M. Z., age thirty-one.   Laborer.

History of Present Condition.—While working on a coal chute a travelling
crane bucket struck him, knocking him down into a cinder pit which had slop-
ing sides. He struck on his right shoulder on the sloping side of the pit, with his
head pointing down into the pit so that the point of his shoulder was carried down-
ward and towards the body.

Examination.—Aside from a few minor lacerations, there was no other injury
except the shoulder. On inspection it was seen that the clavicle rode high
above the acromion and the shoulder was dropped and somewhat narrower than
the one on the opposite side. (See illustrations Nos. 13, 14 and 15.)   Pres-
sure from above downward on the outer end of the clavicle and upward on the
shoulder reduced the deformity without any severe pain and it was thought
that Sayre's dressing would retain the bones in their normal position. Sayre's
dressing was therefore applied snugly, with the addition of a pad over the end
of the clavicle and while it held the bones in fair opposition, the dressing was
so uncomfortable that it was decided to operate.

Operation.—A curved incision was made, starting a little outside
and posterior to the tip of the acromion and running with its con-
vexity forward and its inner horn just touching the anterior surface
of the clavicle, so that no bony points were crossed by the skin incision.
The flap was then reflected backward, joint exposed, and it was found
that the acromio-clavicular ligament was entirely torn and impossible
to suture since its attachments were entirely loosened at the acromial
end. It was, therefore, decided to maintain the position of the bones
by heavy braided silk suture. A hole was drilled through the distal

FIG. 13.

Shows that the clavicle was higher than the acromion and the shoulder dropped.

FIG. 14.
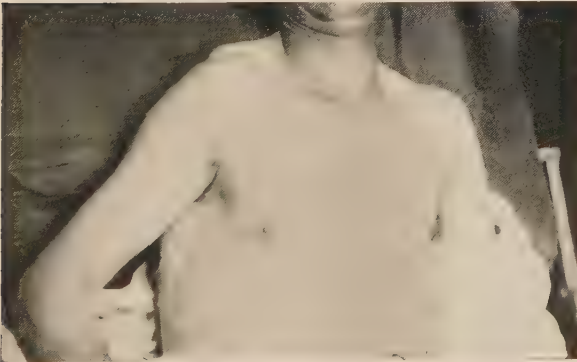
Anterior view of acromio-clavicular dislocation showing clavicle high above the acromion.
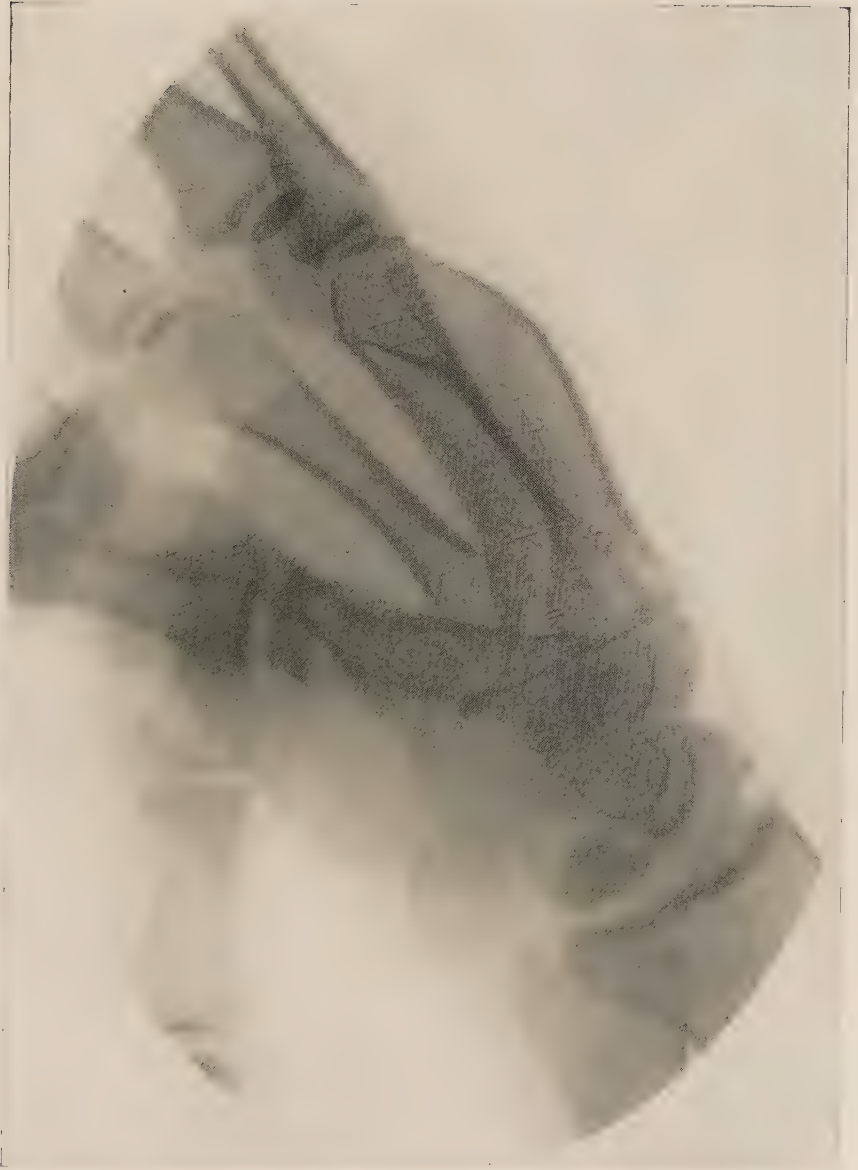
FIG. 15.

X-ray.   Acromio-clavicular dislocation, showing position of clavicle and acromion.

FIG. 16.

X-ray, fracture of second metacarpal, showing posterior bowing of the shaft and the head displaced anteriorly.

end of the clavicle at a right angle to its long axis and another one through the acromion parallel to the first. The heavy braided silk suture was then passed through from front to back in the clavicle and crossed over the top of the joint, the needle being brought back and passed through from front to back again in the acromion. The knot was tied in back of the acromion, where it would be buried and not exert pressure on the bone if anything were caried on the shoulder. This suture retained the fragments in apposition nicely, the wound was closed and the patient put to bed without fixation.

Passive movement of the shoulder was started in about five days and active motion in ten days. Patient returned to work in about six weeks from the time of injury without permanent disability.

Mechanism.—Dislocation of the outer end of the clavicle may be complete or partial and is more often partial than complete. It occurs always when the force is applied downward directly over the acromion process. It may be the result of falling objects striking on the point of the shoulder or a fall from a moving vehicle, the point of the shoulder coming in contact with the ground while the momentum of the body meets the ground at a very acute angle so that the shoulder is dragged down toward the feet by friction on the ground while the momentum of the body goes on, which is approximately the mechanism in this case.

Comments.—A partial dislocation of this joint is often unrecognized and results in pain at the location of the joint when patient returns to work and attempts to do heavy lifting. It partially limits the complete arc of abduction if the acromion drops as a result of torn ligaments at this point. The authors have also seen a very considerable number of traumatic inflammations in this joint as result of partial dislocation and traumatism which have been unrecognized for long periods of time and patients accused of malingering.

If this joint is involved, there is tenderness immediately over the joint, although the pain may be referred as a general shoulder pain. Pain is also elicited by pressure on the head of the humerus, which forces the scapula inward and consequently the acromion against the end of the clavicle. Shrugging of the shoulder gives pain and abduction of the arm beyond a right angle is usually impossible. In cases of chronic inflammatory process in this joint, a complete resection of the joint with the bones retained according to the method described

for the treatment of dislocation is indicated. It is our opinion that this joint should not be fixed by screws or plants, inasmuch as it interferes with the free motion of the shoulder.

FRACTURE OF THE SECOND METACARPAL

M. K., age thirty-one. Laborer.

History of Present Condition.—On January 8, 1920, patient sustained a fracture of the second metacarpal which was treated by a palmar splint. He now complains of pain in the palm of the hand when he grasps his tools or lifts anything which puts pressure on the palm of his hand.

Examination (April 22, 1920).—Examination shows a posterior and radial bowing of the shaft of the second metacarpal, a shortening of the index finger, slight flexion at the metacarpal-phalangeal joint, limitation of motion in the index finger of about 45 degrees or flexion. A bulging can be felt in the palm of the hand just proximal to the normal location of the head of the second metacarpal and when the index finger is forced, a pull can be felt on the most prominent part of the bulge on the dorsum of the metacarpal.

The X-ray shows a marked posterior bowing of the shaft of the second metacarpal with the head displaced anteriorly, as the result of a perfectly healed fracture. There is considerable thickening of the shaft, but the line is smooth and there is no considerable amount of excess callus. (See illustration Fig. 16.)

Comments.—The deformity in this case which is most prominent is most unimportant, namely, a bulging on the back of the hand. The thing which is most important is that the head of the second metacarpal has been angulated forward and pulled toward the wrist and gives a bulge into the palm of the hand which comes in contact with every object that the man grasps in his hand, putting pressure on the soft tissues between this bony prominence and the hard object which is grasped.

In fractures of the metacarpals, a posterior splint applied over the bone with a light padding between the splint and the bone retains the fragments in apposition much better than an anterior, because the dorsum of the metacarpals is flat, whereas the palmar portion is a decided arch. The interossei and lumbricales tend to pull the distal fragment of the bone into flexion. There is a serious disability in this hand as a result of this injury which should have given no disability at all if the splint had been properly placed on the posterior surface, holding the distal fragment in line against the pull of the interossei and lumbricales. If the fracture is oblique and cannot be retained in position by splinting, then an extension made by a splint bound to the forearm and extending beyond the ends of

the fingers with adhesive plaster extension around the finger and elastic attached to the end of the splint, putting constant traction on the finger, will become necessary to maintain the fragments in apposition until sufficient union has taken place to allow splinting without slipping of the fragments. It is not necessary to keep up the extension except for a sufficient length of time to allow the bones to become somewhat adherent. Splinting must be applied after the extension is taken off, to prevent angulation as result of the pull of the muscles, which will occur for a considerable number of days longer than will the actual slipping.

The fault with the palmar roller bandage is that it cannot be held sufficiently snug between the head of the metacarpal and the thenar and hypothenar eminence to prevent the interossei and lumbricales from pulling the head of the metacarpal toward their origins and, therefore, if this method of splinting is applied, numerous X-ray pictures must be taken at frequent intervals to determine what is taking place between the fragments.

Surgery

POTT'S FRACTURE (REVIEW OF EVERSION FRACTURES AT ANKLE)

By CARL DaCOSTA HOY, A.M., M.D., F.A.C.S.

Columbus, Ohio

THERE is at present a great deal of *confusion* in connection with injuries at the ankle as to *terminology, correct diagnosis* and *proper treatment*. This injury at the ankle joint was first described by Sir Percival Pott in 1756, and has been designated by English surgeons as a *Pott's fracture*.

(*a*) " In the year 1756, Mr. Pott suffered an accident which seems to have had considerable influence on his future life. As he was riding in Kent St., Southwark, he was thrown from his horse and suffered a compound fracture of the leg. Conscious of the dangers of a fracture of this nature, he would not suffer himself to be moved until he had made the necessary dispositions. He sent for two chairmen to bring their poles and patiently lay on the cold pavement (it being the middle of January) until they arrived. He had them nail a door to the poles and was carried to where he lived on Watling Street, near St. Paul. At a consultation of surgeons it was decided to immediately amputate. Mr. Nourse, after examining the limb, conceived that there was a possibility of preserving it. Attempt was acquiesced in and succeeded. There was no infection and the wound healed by first intention. The appearance of Mr. Pott as an author was an immediate effect of this accident, and his description of this accident remains as a classic to this day. The following is his description:

" 'This type of case, according to the general manner of treating it, gives infinite pain and trouble both to the patient and the surgeon and very frequently ends in the lameness and disappointment of

the former and the disgrace and concern of the latter—I mean the fracture of the fibula attended with a dislocation of the tibia.

" ' Whoever will take a view of the leg of a skeleton will see that although the fibula be a very small and slender bone and very inconsiderable in strength when compared with the tibia, yet the support of the lower joint of the limb (the ankle) depends so much on this slender bone, that without it the body would not be upheld, nor locomotion performed, without hazard of dislocation every moment. The lower extremity of this bone which descends considerably below that end of the tibia, is by strong and inelastic ligaments firmly connected with the last-named bone, and with the astragalus, or that bone of the tarsus which is principally concerned in forming the joint of the ankle. This lower extremity of the fibula has, in its posterior part, a superficial sulcus for the lodgement and passage of the tendons of the peronei muscles, which are here tied down by strong ligamentous capsule and have their action so determined from this point or angle, that the smallest degree of variation from it, in consequence of external force, must necessarily have considerable effect on the motions they are designed to execute and consequently distort the foot. Let it also be considered that upon the due and natural state of the joint of the ankle, that is, upon the exact and proper disposition of the tibia and fibula, both with regard to each other and to the astragalus, depend the just disposition and proper action of several other muscles of the foot and toes; such as gastrocnemi, the tibialis anticus and posticus, the flexor pollicis longus and the flexor digitorum pedis longus, as must appear demonstrably to any man who will first dissect and then attentively consider these parts.

" ' If the tibia and fibula be both broken, they are both generally displaced in such manner that the inferior extremity, or that connected with the foot, is drawn under that part of the fractured bone which is connected with the knee; making by this means a deformed, unequal tumefaction in the fractured part, and rendering the broken limb shorter than it ought to be, or than its fellow, and this is generally the case, let the fracture be in what part of the leg it may.

" ' If the tibia only be broken and no act of violence, indiscretion or inadvertence be committed, either on the part of the patient or those who conduct him, the limb most commonly preserves its figure and length; the same thing generally happens if the fibula only be broken

in all that part of it, or in any part of it between its upper extremity and within two or three inches of its lower one.

" ' I have already said and it will obviously appear to every one who examines it, that the support of the body and the due and proper use and execution of the office of the joint of the ankle, depend almost entirely on the perpendicular bearing of the tibia upon the astragalus; and on its firm connection with the fibula. If either of these be perverted or prevented so that the former bone is forced from its just and perpendicular position on the astragalus; or if it be separated by violence from its connection with the latter, the joint of the ankle will suffer a partial dislocation internally, which partial dislocation cannot happen without not only a considerable extension, or perhaps laceration of the bursal ligament of the joint, which is lax and weak, but a laceration of those strong tendinous ligaments, which connect the lower end of the tibia with the astragalus and os calcis and which constitute in great measure the ligamentous strength of the joint of the ankle. This is the case when by leaping or jumping, the fibula breaks in the weak part already mentioned; that is, within two or three inches of its lower extremity. When this happens, the inferior fractured end of the fibula falls in toward the tibia, that extremity of the bone which forms the outer ankle is turned somewhat outward and upward and the tibia having lost its proper support and not being of itself capable of steadily preserving its true perpendicular bearing, is forced off from the astragalus inwards, by which means the weak bursal or common ligament of the joint is violently stretched if not torn, and the strong ones which fasten the tibia to the astragalus and os calcis are always lacerated; thus producing at the same time a perfect fracture and a partial dislocation, to which is sometimes added a wound in the integuments, made by the bone at the inner ankle. By this means and indeed as a necessary consequence, all the tendons which pass behind or under, or are attached to the extremities of the tibia and fibula, or os calcis, have their natural direction and disposition so altered, that instead of performing their appointed actions, they all contribute to the distortion of the foot, and that by turning it outward and upward.

" ' When this accident is accompanied, as it sometimes is, with a wound of integuments of the inner ankle and that made by the protrusion of the bone, it not infrequently ends in a fatal gangrene. But

in its most simple state, unaccompanied with any wound, it is extremely troublesome to put to rights, still more so to keep it in order, and unless managed with address and skill, is very frequently productive both of lameness and deformity ever after.

" ' After what has been said, a further explanation why this is so is unnecessary. Whoever will take even a cursory view of the disposition of the parts, will see that it must be so. By the fracture of the fibula, the dilatation of the bursal ligament of the joint, and the rupture of those which should tie the end of the tibia firmly to the astragalus and os calcis, the perpendicular bearing of the tibia on the astragalus is lost, and the foot becomes distorted; by this distortion, the direction and action of all the muscles already recited are so altered, that it becomes (in the usual way of treating this case) a difficult matter to reduce the joint, and, the support of the fibula being gone, a more difficult one to keep it in its place after reduction. If it be attempted with compress and strict bandage, the consequence often is a very troublesome, as well as painful ulceration of the inner ankle, which very ulceration becomes itself a reason why such kind of pressure and bandage can be no longer continued; and if the bone be not kept in its place, the lameness and deformity are such as to be very fatiguing to the patient, and to oblige him to wear a shoe with an iron, or a laced buskin, or something of that sort, for a great while, or perhaps for life.

" ' All this trouble, pain, difficulty and inconvenience are occasioned by putting and keeping the limb in such a position as necessarily puts the muscles into action, or into a state of resistance, which in this case is the same. This occasions the difficulty in reduction and the difficulty in keeping it reduced; this distorts the foot, and by pulling it outward and upward makes that deformity which always accompanies such accident; but if the position of the limb be changed, if by laying it on its outside with the knee moderately bent, the muscles forming the calf of the leg, and those which pass behind the fibula and under the os calcis are all put in a state of relaxation and nonresistance, all this difficulty and trouble do in general vanish immediately; the foot may easily be placed right, the joint reduced, and by maintaining the same disposition of the limb, everything in general will succeed very happily, as I have many times experienced.' "

NOMENCLATURE

"(b) French surgeons apply the name of Dupuytren to the common as well as to the exceptional and severe injury. Systematic descriptions include part of the subject under 'Dislocations' and part under 'Fractures.' Sir Astley Cooper and others spoke of the tibia as the bone dislocated from the astragalus and foot, which had this practical drawback—that it misdirected attention from the necessity of returning the atragalus and the rest of the foot into place. Before introduction of examination by the X-rays it was difficult to distinguish the slighter varieties of dislocation and fracture from sprains, and as to the severe injuries, the descriptions as well as the specimens in museums have been in many cases drawn from instances of primary amputation. Such specimens are not necessarily examples of the condition existing in cases which just escape primary amputation. The common accident called Pott's fracture, is characterized by the yielding of the structures on the inner side of the ankle, the internal lateral ligament and the tip of the internal malleolus. This is followed by a fracture of the fibula, just above the external malleolus. Whether by a continuation of the force causing the accident, or owing to the forcible contraction of the peronei muscles and of the calf muscles through the tendo achillis, the foot is everted into a position of valgus, and the astragalus and foot are drawn backward so that the foot is in the position of equinus. The relative degree of valgus and equinus varies, but the peronei and calf muscles are unopposed owing to the loss of resistance of the internal lateral ligament, as well as to the overstretched state of the tibialis posticus and the flexor longus hallucis.

" The primary idea of Dupuytren was a displacement of the foot upward, so that the limb was actually shortened. His original description was from an old standing case examined clinically, and he supposed the accident was caused by a forcing apart of the tibia and fibula by a rupture of interosseous ligaments, so that the astragalus was impacted between them. Such an accident was described by Fergusson and Bryant; recently Millikeir has published an X-ray photograph. The museum specimens taken from primary amputation show displacement upward of the astragalus and foot, exacerbation of the less severe injuries in which the fibula is fractured

FIG. 1.

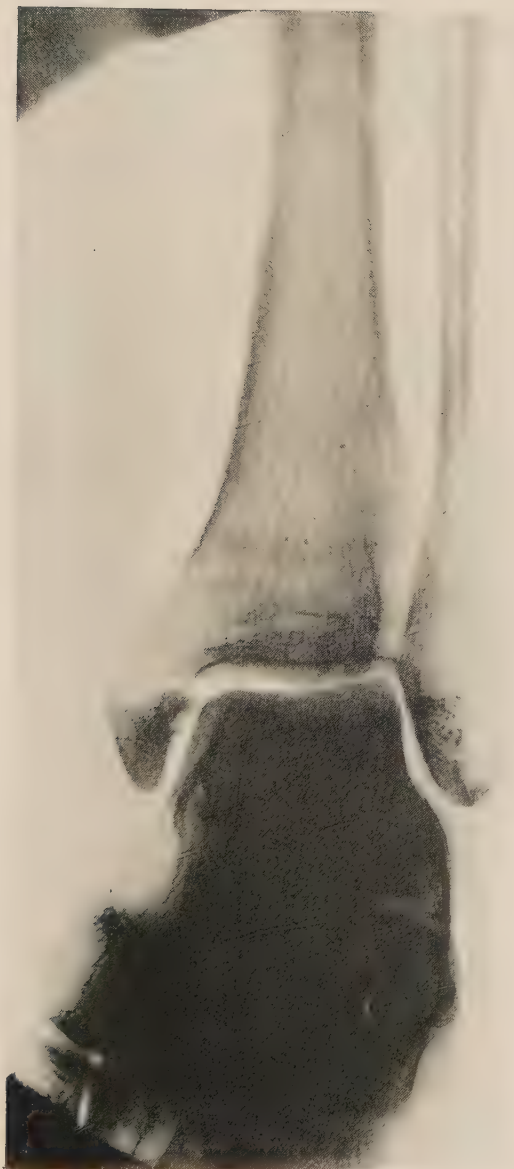
Pott's fracture. Fractured internal malleolus, comminuted fracture of fibula 3½ inches above external malleolus. Eversion of foot.

Fig. 2

Pott's fracture.   Lateral view.

Fig. 3.

Pott's fracture.   Showing fractured internal malleolus.

Fig. 4.

Pott's fracture. Showing oblique fracture of fibula just above the joint line.

obliquely and comminuted, involving the external malleolus owing to the outer rim of the upper surface of the astragalus being forced upward and backward. There is along with this a separation of the lower fragment of the fibula from the tibia to either a rupture of the interosseous ligament or to the tearing away of the posterior edge of the articular surface of the tibia. But the fibula above the fracture remains attached to the tibia. The astragalus is thus displaced upward external to and behind the lower end of the tibia, and it with the foot may be twisted on a vertical axis so that the toes point outward to an angle of 45 degrees or more from the middle vertical line. The comminuted lower fragment of the fibula with the external malleolus retains its apposition with the side of the astragalus, but by so much as the astragalus is rotated on its anteroposterior axis outward, by so much does the fibular fragment protrude on the outer side. Not only may the internal malleolus be fractured, but it may include a portion of the tibia, and this inner fragment then tends to be displaced so as to lie under the articular surface of the tibia, in the gap left by the displacement of the astragalus. French surgeons also use the name of Boyer and Maisonneuve. Boyer described a case of displacement of the foot outward without fracture of the fibula, the head of the fibula being separated from its articulation with the tibia and driven upward. Maisonneuve laid stress upon a sign of fracture of the fibula, one thumb being placed on the tip of the external malleolus and the other thumb on the upper end of the lower fragment, by pressing alternately a rocking movement could be obtained.

FREQUENCY OF MALUNION IN FRANCE

" The Societe de Chirurgie has had the subject under consideration on many occasions during a long series of years. Owing to an increased frequency of cases of malunion among soldiers there have been recently a number of discussions at meetings of the Societe. This increased frequency may be explained by the exigencies of military service but it may also be due in part to an ignoring of the prescriptions as to reduction long ago laid down by authorities.

" In 1913 Chaput referred to the accidents causing a fracture of the malleoli with a dislocation of the foot outward and backward, which he called Depuytren's fracture. Many cases were found mal-

united after taking off the plaster case, although supposed to have been reduced.

"For the treatment of such malunion, three procedures had been practised.

"(1) Tillaux had advised that the heel should be seized with one hand, the instep by the other, whilst the leg is held by an assistant. The foot is then flexed to a right angle and strongly turned inward. The fallacy of such a method is that the luxation backward is not reduced, only the displacement outward.

"(2) The way to reduce a backward dislocation is to place one hand behind the heel and the other in front of the leg, just as one takes off another's boot.

"(3) A more forcible reduction is obtained by placing the heel upon a block of wood or upon the edge of a box and making pressure.

"Houzel reported through Quenu the case of a non-commissioned officer in the artillery, aged 24, who was thrown off owing to the bursting of a shell, and was dragged by his horse with a foot in the stirrup for 200-300 metres. The foot was simply bandaged at the ambulance, and he was sent back to Paris. The day following the accident he was found to have a Depuytren's fracture, with the foot displaced backward. Under general anæsthesia the foot was stated to have been reduced; also the fractures noted by radiography. Two months later the foot was found to be in a position of marked valgus, being displaced outward at an angle of 140 degrees with the outer side of the leg. The ankle was then put in a plaster case for a further six weeks. The following deformities were noted by Houzel: The foot was in a position of marked valgus, but the displacement beckward had been reduced; the internal malleolus had been fractured at its base and dragged apart by the astragalus so as to be in line with the axis of the tibia. The external malleolus had been fractured obliquely, whilst the lower part had been divided into two; one fragment still connected with the astragalus, the other displaced upward so that the tip was nearly on a level with the articular surface of the tibia. The pointed end of the upper fragment rested attached to the tibia. Between the lower end of the upper fragment and the rest of the malleolus was a space of 1 cm., into which bulged the outer rim of the astragalus.

"Quenu saw the case nine months after the injury and six months after the osteotomy, when the conditions as above described were found

to have undergone no improvement as the result of the osteotomy. Consequently the internal malleolar fragment and also the astragalus were removed. The external malleolar fragments were left, but a silver wire suture was inserted to fix the fibula to the cuboid in order to prevent displacement of the os calcis inward. The foot was kept in plaster for fifty days. A year after the injury the foot was fixed at right angles to the leg, and the line of the crest of the tibia corresponded with the second metatarsal, while the sole was placed flat on the ground. There were slight movements of flexion and extension at the ankle without lateral movement. The displaced malleolar fragments gave no trouble. With a little thicker sole to his boot he could walk several kilometres without fatigue.

" Quenu said that in the course of the last forty years the subject had been frequently discussed in the Societe de Chirurgie.

" In 1880 the treatment most in favor was wrenching, or wrenching combined with refracture, which might be facilitated by using an osteoclast. In 1887 osteotomy received the chief support, osteotomy first of the fibula, and if that failed then also of the tibia. The tibia might be simply divided or a wedge of bone excised. In 1898 a double osteotomy of the fibula, one section above and one through the external malleolus, was advocated, with an osteotomy of the tibia added. Partial atypical excision of the ankle was preferred by Lucas-Championniere in 1880, and the cases were reported to the Societe from time to time. Quenu had in 1907 directed attention in particular to the displacement consequent upon the separation of the fibula and tibia, which could be remedied by removing the astragalus.

" By means of the X-rays it had become possible to form an exact idea of the extent of the fracture and of the displacements, and this had become an essential preliminary to the reduction by operation.

" The cases might be divided into two classes:

" (a) In which there is a backward displacement of the foot without lateral deviation. In this case the chief obstacle to the return of the astragalus into the tibiofibular mortise is the fractured internal malleolus, while the astragalus is impacted in the gap made by the separation of the tibia and fibula. In such a case it is necessary to get rid of the obstruction presented by the internal malleolus, which should be excised. This is better than attempts to loosen it and fix it

in position. In addition the fibula may be divided. But it is very likely best to excise the astragalus.

" (b) The second class of injury is that to which Houzel's case belongs, in which there is not only displacement backward, but deviation of the foot into a position of valgus. In such the lower end of the fibula and external malleolus are fractured obliquely and the lower malleolar fragment is shifted upward so as to override the end of the shaft of the fibula. Also, instead of the rupture of the interosseous ligament, the posterior margin of the tibia is torn off. In such cases the essential treatment is astragalectomy.

" Dujarier had operated on four cases of badly united Depuytren's fracture, but had not kept the patients under observation after recovery.

" CASE I.—A mason, age twenty-eight, had injured himself a month before, but was at first treated for a sprained ankle. The radiograph showed a Dupuytren's fracture with the astragalus and foot displaced backward and the fibula fractured above the tip of the malleolus. The lower fragment with the malleolus had been displaced upward and backward so as to lie behind the tibia, from which the internal malleolus was detached. The man could not walk. An incision was made along the posterior and inner border of the tibia which curved forward at the tip of the internal malleolus. The detached malleolus was raised but could not be reduced into place. Thereupon a horizontal slice 5 mm. thick was removed from the lower end of the tibia, after which, by applying force the fragments were reduced. The internal malleolus then came into normal apposition with the tibia and with the astragalus. The wound was closed without drainage of a plaster case applied. The patient was lost sight of after leaving hospital.

" CASE II.—A woman, aged forty-seven, had sustained a Dupuytren's fracture two months previously; the astragalus and foot were displaced backward, but there was no lateral deviation.

" Under spinal anæsthesia with stovain, a curved incision was made around the lower end of the fibula and the astragalus was excised piecemeal. The internal malleolus and part of the horizontal articular surface of the tibia had been detached, displaced backward, and there fixed. This fragment could not be freed and brought forward until after the removal by rongeur forceps of the anterior border of the

Fig. 5.

Pott's fracture.   1, Fibula fractured; 2, Internal malleolus fractured; 3, Note wide separation of tibia, and fibula, due to torn interosseous ligament.

Fig. 6.

Ancient Pott's fracture. Showing fractured fibula 2½ inches above external malleolus with solid union. Fractured internal malleolus with union. Some eversion of foot.

Fig. 7.
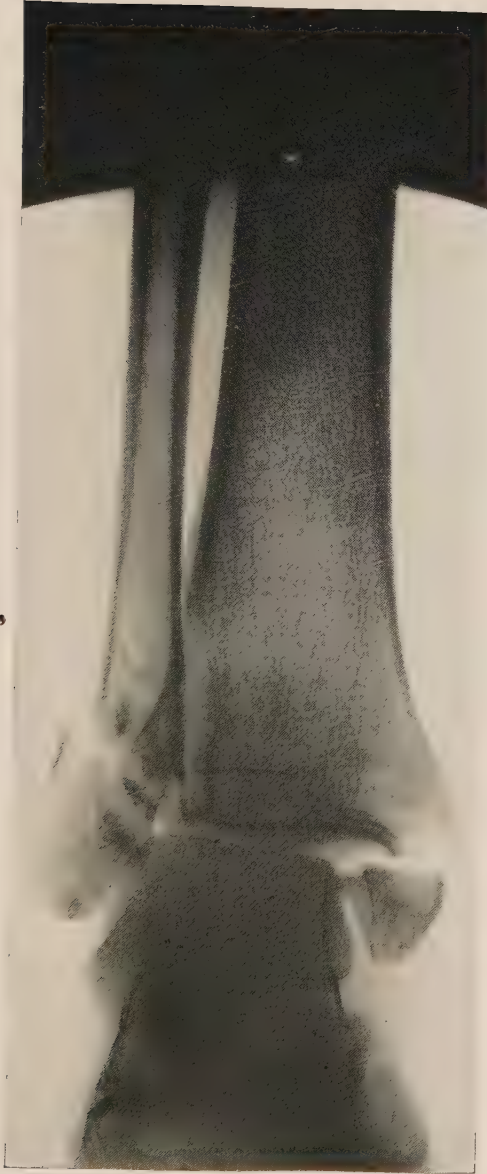
Pott's fracture. Showing fractured internal malleolus
and fractured fibula ½ inch above joint line.

Fig. 8.

Pott's fracture. Showing a low fracture of fibula.

articulating surface, which constituted an obstructing ridge. The wound was united without drainage and firmly bandaged, but not in plaster. When leaving the hospital the patient could walk, but with difficulty.

" CASE III.—A woman, aged forty-nine, eight months before, as the result of a false step, sustained a Dupuytren's fracture. The foot was subluxated outward and a little backward so that it was outside the axis of the limb and the crest of the tibia was in line with the inner border of the great toe. The internal malleolus was prominent and the sole of the foot looked outward. Walking caused pain in the instep and outer part of the foot, which was swollen by œdema.

" Under spinal anæsthesia by stovain, the fibula was exposed and divided obliquely at the level of the fracture. Then a curved incision like a capital J was made around the internal malleolus, which was loosened from the tibia, and scar tissue excised from between the tibia and the astragalus. The bones were very friable, and by means of a lever inserted between the astragalus and tibia, with much difficulty, the displacement outward of the foot was overcorrected so as to assume a position of varus. The two incisions were united without drainage and a plaster case applied, in order to maintain the varus position with the heel brought well forward. The plaster was reapplied until after a month, when massage was adopted and the patient began to move about with a stick. Six weeks after the operation the patient could walk without a stick, she could bend the knee and place the sole of the foot flat on the ground. A boot was ordered with a sole thicker on the inner side.

" CASE IV.—A man, aged forty-eight, sustained a Dupuytren's fracture and underwent two operations for its replacement. Eight months he presented a marked flat foot with rotation of the great toe inward. Under spinal anæsthesia both the tibia and fibula were divided above the malleoli by an osteotomy, after which the valgus and the internal rotation of the great toe could be corrected. The result was that the axis of the limb was brought into the normal line with the astragalus and the patient was able to walk fairly well.

" The foregoing cases are instances of three methods: the replacement of the fragments through an open incision, which is attended with great difficulty; astragalectomy, which is especially indicated

when the foot is displaced backward; and osteotomy above the malleoli, which allows of the correction of the valgus.

"Delbet had in early days taught that recent cases of Dupuytren's fracture could be readily reduced and malunion prevented. Failing in that, the malunion could be remedied by linear transverse osteotomy of the tibia and fibula. But he had been forced to change his opinion. For old-standing cases he had excised the internal malleolus and then divided the callus, fixing the fragments, especially of the external malleolus. In this way the valgus and the displacement backward could be remedied, but there was apt to persist a condition of the equinus. He had for this removed ossified callus from the anterior border of the tibia, and also divided the achillis. All this formed a complicated procedure, and the results were in some cases only poor. He had therefore in his last case followed Quenu and removed the astragalus. But the principal thing was to reduce properly the Dupuytren's fracture while still recent.

"Tuffier had generally employed for the simpler cases osteotomy above the line of fracture. He strongly opposed attacking the callus at the site of fracture; in order to complete reduction by this method much destruction is done, and the results are generally deplorable. When the deformity is very marked, as in a case operated upon a short time ago, astragalectomy was the most satisfactory procedure.

"Lecene reports six cases:

"CASE I.—A male, aged fifty, was treated immediately by fixation in plaster and eleven weeks later was found to have a marked displacement of the foot backward, so that the continuation of the long axis of the tibia passed in front of the head of the astragalus, but the lateral deviation was not great. The posterior border of the tibia was resting on the neck of the astragalus. The fibula was fractured 3 cm. above the external malleolus and the internal malleolus had been torn off. An incison was made along the anterior border of the fibula as far as the calcaneocuboid joint. The lower fragment of the fibula was excised, for it had been so displaced as to be almost horizontal. Then with a saw the upper surface of the astragalus and the lower surface of the tibia were removed, when the foot could be readily reduced into place. It was fixed into position by a silver wire through the tibia and astragalus, holding the foot at a right angle. A

Fig. 9.
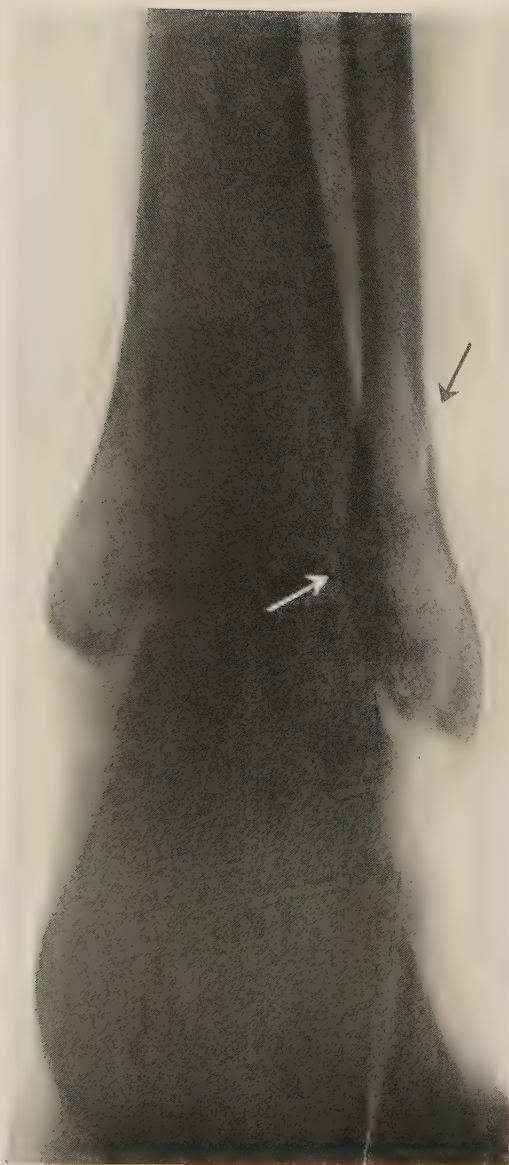

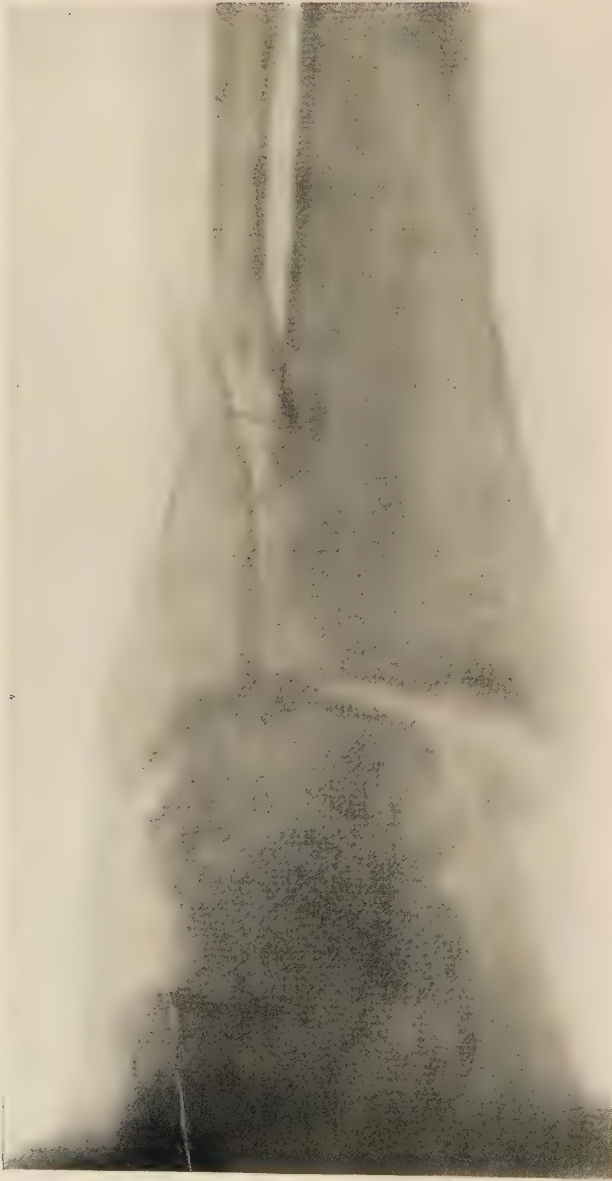Pott's fracture. Fractured internal malleolus.

Fig. 10.

Pott's fracture.   Showing comminuted fracture of fibula 2½ inches
above external malleolus.

FIG. 11.

Pott's fracture. Showing fractured fibula above joint line.

FIG. 12.

Pott's fracture.

year later he could walk readily without trouble, and the foot remained in the above mentioned position.

" Case II.—A woman, aged forty-seven, had been treated by plaster for six weeks after the fracture, but the patient never regained power of walking for more than 200 to 300 m., and that only with the aid of two sticks.

" Two years after the accident the foot was found dislocated backward so that the anterior border of the tibia was at the level of the joint between the scaphoid and internal cuneiform. The fibula had been fractured above the external malleolus and the lower fragment had been turned so as to be almost horizontal. The internal malleolus had not been torn off, but the posterior border of the tibia had separated, around which had formed an exuberant mass of callus united with the astragalus.

" The incision was the same as in the previous case, together with the removal of the lower fragment of the fibula. The astragalus and the callus behind the tibia were next removed, but the internal malleolus was preserved. The foot could then be reduced into good position. It was kept fixed in plaster for five weeks, after which the patient began to walk with a stick. Six months later the patient expressed herself as much pleased; she could walk without a stick, go up and down stairs readily and walk about her garden without trouble.

" Case III.—A woman, aged fifty-three, was treated with the limb in plaster for five weeks. After that she could not get about even with a stick, because her ankle gave way on the inner side. Five months after the accident the foot was found in extreme valgus, there was a fracture 2-3 cm. above the external malleolus and the axis of the tibia was in line with the neck of the astragalus. The internal malleolus was torn off. An incision was made along the posterior border of the fibula ending over the outer margin of the astragalus. The fibrous union of the fibula was divided with a knife. The astragalus, the head of which was in contact with the anterior border of the lower end of the tibia, was excised. The fibrous union of the internal malleolus was divided sufficiently to replace it. Then the lower fragment of the fibula was fixed to the upper by catgut sutures. The foot was placed in an overcorrected position of varus. Seven months later the patient was walking well, with the foot in good position and some slight movements of flexion and extension at the ankle.

" Case IV.—A man, aged forty-five, was thrown and received a dislocation of the right shoulder and a fracture of the left external malleolus with a marked dislocation of the foot backward. The shoulder dislocation was reduced and the foot put in plaster. Five weeks later an X-ray photograph showed the displacement backward of the foot so that the anterior border of the tibia was in line with the astragalo-scaphoid joint. The fracture of the fibula was a short distance above the malleolus, but the internal malleolus was not fractured. There was plainly shown a wedge-shaped fragment detached from the posterior border of the lower end of the tibia. An incision was made along the anterior border of the fibula, the fibrous union between the fragments divided, and following this the fragment of the posterior border of the tibia removed. While the foot could now be reduced, the dislocation tended to recur owing to the loss of the posterior margin of the tibia. Hence astragalectomy was done. He was treated by plaster for a month and then began to walk with a stick. Three months after the operation the foot was in good position; he could walk without trouble, the foot being at right angles with the leg, and there were slight movements of flexion and extension.

" Case V.—A soldier, aged thirty-eight, four months after the accident had flat foot, and the X-ray showed a fracture of the fibula, about 8 cm. above the external malleolus; the internal malleolus had been broken off and turned under the tibia. The fibula was widely separated, and the foot was dislocated backward so that its heel was in contact with the posterior surface of the tibia. The operation was similar to the previous case, including the removal of the astragalus. Three months later the man could march well without a stick.

" Case VI.—A soldier, aged thirty-eight, who had been treated by splints and massage, was found three and a half months after the accident with marked valgus and dislocation of the foot backward. The anterior border of the lower end of the tibia corresponded with the astragalo-scaphoid joint. The fibula was fractured 4-5 cm. above the external malleolus. The internal malleolus had been torn off.

" After an operation similar to the foregoing cases, the man recovered so that three months after the operation he had a firm foot and walked well without a stick.

" Savariaud regarded the reduction of such fractures when recent as an easy matter under spinal anæsthesia. The cases of malunion he

had undertaken had been reduced by dividing and excising the
fibrous unions, and he had attained a good result, especially because he
had preserved the two malleoli. But in his last case he had not been
so successful; the foot remained rigid with a pronounced prominence
of the internal malleolus.

" Robineau had operated on two soldiers injured during the war.
In the first he had aimed to divide the fibrous unions, but had to
extend this to an irregular excision. The result was a good position,
but the patient suffered much pain in the leg and instep. In the second
instance suppuration followed, and the displacement recurred; an at-
tempt during the suppuration to lever the astragalus back into position
failed and so the astragalus was removed. After prolonged suppura-
tion for three months some sequestra were removed from the tibia.
After this healing set in with the foot in good position, but the man
was transferred before this was complete.

" Cuneo had performed astragalectomy for malunion follow-
ing a Dupuytren's fracture; but the patient, discontented with the
result, threatened an action at law and claimed damages. The start-
ing point of the claim was the statement by some surgeons that
removal of the astragalus was never indicated in such cases. He
was glad to find that a number of the society's members held just the
opposite view.

" Reynier held that for the simpler cases osteotomy of the fibula
permitted the reduction of the foot. For the more complicated cases
the removal of callus is necessary. As for astragalectomy, it suc-
ceeded in some cases, but not in all. A man met with a severe motor
accident, sustaining a Dupuytren's fracture on each side. Malunion
occurred so that he could only move with crutches, resting on his toes.
Reynier removed the astragalus on each side. The feet were thus
brought into good position, but the functional effect was not brilliant;
the patient walked badly and that with two sticks.

" Fredet had had a good result after osteotomy of the fibula in a
case in which there was marked valgus.

" Auvray had in three cases adopted osteotomy of both fibula and
tibia in an oblique line so as to favor reduction. He was himself
content with the immediate result, but had not informed himself as
to the later results.

" Mauclaire was inclined to believe that the external deviation of

the foot often recurred when the patient began to walk, although at
the time of the accident the fracture had been reduced.   He had
operated on three cases of valgus following fracture of both tibia and
fibula by osteotomy of the tibia.   He had removed the astragalus in
one case in which there was simply a dislocation of the foot back-
ward.   In two cases he had divided the fibula at the junction of the
external malleolus with a shaft when the deformity was limited to
a valgus position.   The results had been very good.   In two cases
it was necessary, in addition, to divide the base of the internal malle-
olus.   In four cases more was necessary; after dividing the external
mallcolus and the internal malleolus, the astragalus was removed in
three cases, and the astragalus and a posterior fragment of the tibia
in a fourth case.   There was a good result ultimately in the three
former, but recovery was slow; in the last case, at the end of a year
walking was painful and there was some valgus.   In the treatment after
the operation active massage was employed with passive movements,
even under a general anæsthetic when othewise too painful.

" Souligoux recalled a case of an atypical excision of the ankle,
which he had exhibited, after recovery, to the Societe in 1913.   The
man, two months after the accident, had the foot in marked equinus,
it being dislocated backward and outward, so that he could only
walk on his toes, and he demanded amputation.   The X-ray showed
a large fragment detached from the back of the tibia, and in between
was fixed the posterior margin of the astragalus.   The anterior border
of the tibia was in contact with the head of the astragalus, entirely
preventing the foot from being brought to a right angle with the leg.
Around all the fracture and extending up the fibula were signs of
ossified callus.   On laying open the joint with the object of remov-
ing the astragalus, so much fibrous and ossifying callus was met with
that it was decided to gouge away the under surface of the tibia until
the foot could be brought up to a right angle.   When exhibited to
the Societe two years after the operation the man walked perfectly,
the foot was in good position, and there was some movement of flexion
and extension between the tibia and the astragalus.

" At the following meeting of the Societe Delbet returned to the
subject of astragalectomy, which he had done, particularly with the
object of relieving the equinus.   He had just seen his patient again.
The function result was not good, for the patient tended to walk with
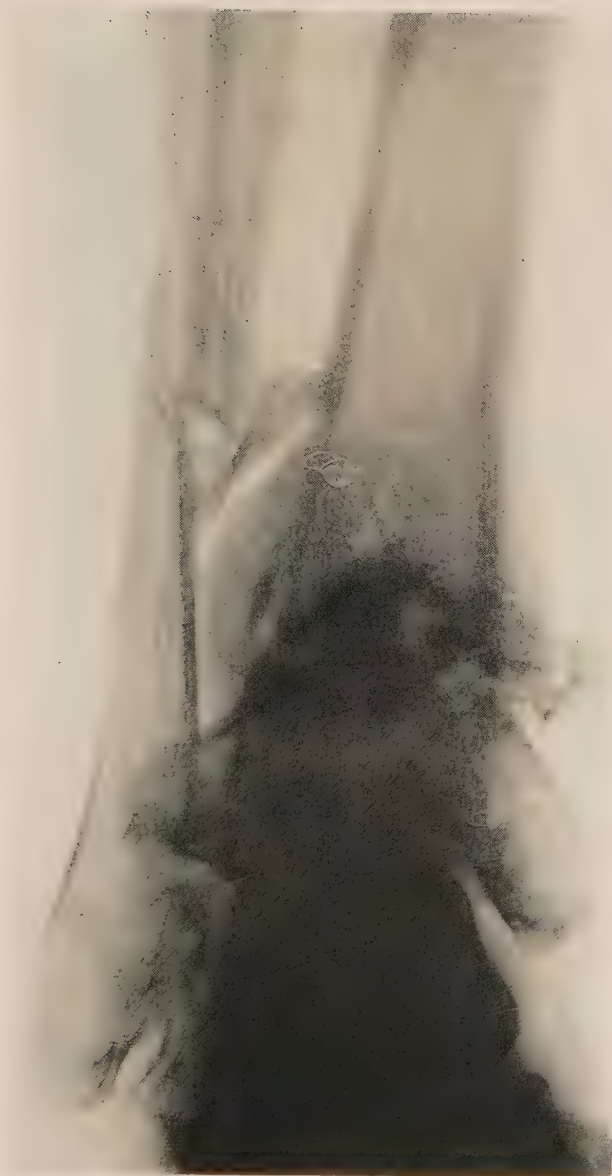
Fig. 13.
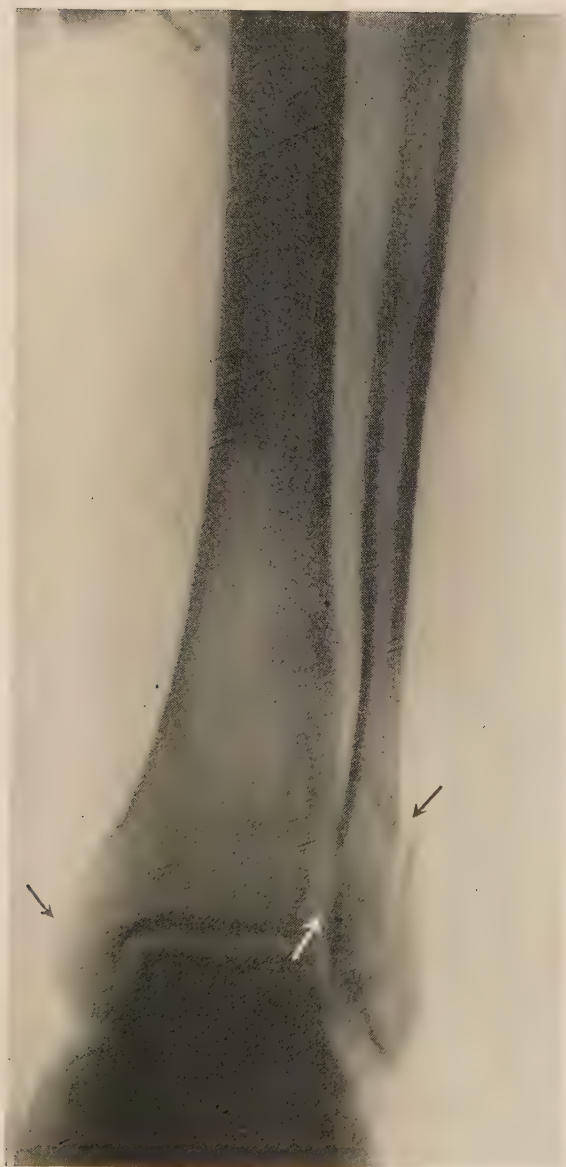
Pott's fracture., Showing fractured internal malleolus. Fractured
fibula just above joint.

Fig. 14.

Pott's fracture. Showing fractured fibula 3 inches from
tip of external malleolus and slight fracture of tip of
internal malleolus.

FIG. 15.

Types of fractures above ankle; not a Pott's fracture.

FIG. 16.

Fracture above ankle, not a Pott's fracture.

the foot everted. The X-rays show a large fragment detached from the posterior border of the tibia against which the astragalus had rested. Delbet suspected his patient of aiming to recover compensation from the doctor who had first treated him. The case, however, showed that astragalectomy was successful, but only in certain cases.

" In another case marked by valgus and a separation of the lower ends of the tibia and fibula, the fracture of the fibula was 13 cm. above the top of the external malleolus. Delbet began by removing the callus around the internal malleolus, then that separating the tibia from the fibula; he next gouged away the under surface of the tibia and removed the fragment detached from the back of the tibia. This freed the inner aspect of the fibula for the length of 6 cm. By this means the foot could be brought forward, so that the astragalus was placed between the two malleoli, and the result was very much better than if the astragalus had been removed.

" Auvray reported the late result in a patient upon whom he had operated in 1915 by osteotomy of both malleoli. Before that, walking had been almost impossible. The patient now had written to say that in shoes without heels the sole of the foot rested flat on the ground, but with heels this was incomplete. She could walk for a time, but after two or three hours on her feet the foot swelled and the leg felt heavy; walking was then painful. While she did not need a stick for a short distance, she used one for a longer walk on the road. In spite of this limitation, she expressed herself as well pleased, for without operation she would have been laid up entirely. The result is not ideal, but no more would have been gotten from an astragalectomy.

" Another case, a soldier, had fallen downstairs on December 5, 1917. Auvray found him in the hospital with the fracture malunited, the foot being turned outward and displaced backward, so that walking was much hindered. Osteotomy through both malleoli was done on February 20, 1918, followed by deep sutures through the periarticular fibres and superficial ones for the skin. The deformity was well corrected as the result of this operation; the foot could be placed flat on the ground; the patient could walk without a stick, but not very far; he could ride a bicycle and had resumed his former occupation. The leg was wasted and the foot swollen over the ankle; the patient had pain at change of weather and when fatigued. There was no movement of the ankle-joint. But he was quite satisfied with the result.

SUMMARY

" The number of cases brought before the Societe de Chirurgie of malunion after injuries at the ankle is impressive. Nearly all were cases classed by English surgeons under the title of Pott's fracture. An X-ray examination both before and after reduction, at any rate after manipulation for reduction, before the photograph is obscured by plaster-of-Paris, is of great importance. But it may be recognized the separation of the posterior margin of the articulation of the tibia, which particularly favors a recurrence of the dislocation of the astragalus backward. The essential displacement of the astragalus with the rest of the foot is by a rotation outward into a position of valgus, and a rotation backward into one of equinus—the relative degree of valgus and equinus varying. It is quite exceptional in those cases which just escape primary amputation for there to be an additional displacement of the astragalus with the foot upward. The manipulation in order to reduce must be such that the deformity shall be a little overcorrected, the foot a little turned into a position of slight varus, and the heel brought so forward that the foot forms with the leg a right angle or somewhat less. This can be done by the operator placing one hand behind the heel while the other makes counter-pressure on the lower third of the leg. The reduction is then opposed by the spasm of the calf and peronei muscles, which shortly after the accident can be overcome by anæsthesia with the knee flexed.

" But there are illustrations in French surgical work which depict the operator with one hand on the instep and the other at the heel; this suggests extension in the long axis of the limb, which, barring exceptional cases, is not wanted. The same erroneous notion is suggested by Delbet's method. While the ankle is being put up in plaster-of-Paris, extension by a loop round it connected with a cord and weight is kept up until the plaster has dried. In order to overcome the spasm of the calf and peronei muscles, the patient should, as a rule, be fully anæsthetized. This is most certainly accomplished by a general anæsthetic, and the substitution of spinal or local anæsthesia appears of doubtful expediency, owing to the probability that the muscles will not be fully relaxed.

" A few hours after the accident a rigidity of the muscles sets

Fig. 17.

Wrongly called Pott's fracture.   Note inversion of foot.

Fig. 18.

Wrongly called Pott's fracture. An eversion fracture of both
bones 1½ inches above joint.

Fig. 19.

Charcot ankle.   Eversion fracture.   No pain.   Pott's fracture **on** Charcot.   Lateral view.

FIG. 20.

Charcot ankle. Eversion fracture.   No pain.   Pott's fracture on
Charcot.   Antero-posterior view.

in, which often cannot be completely overcome even by deep general anæsthesia. Then the division of the tendo achillis, strongly recommended in former days, *e.g.*, by Bryant and Lucas-Championniere, will allow of the reduction and a light overcorrection of the deformity above alluded to.

" The hurried wrapping up in plaster-of-Paris casing obscures an X-ray examination as well as one with the naked eye. Moreover, the plaster tends to soften and yield, so that, unless the deformity has been overcorrected, a relapse may readily occur. The particular casing much used in France, two lateral strips with circular bands below the knee and around the ankle, tends to yield even more readily than a complete case.

" Lucas-Championniere's recommendation of early massage had the advantage that the foot could be inspected daily.

" But the slight overcorrection has to be kept up for a long time, until the internal lateral ligament and the overstretched tibialis posticus and flexor longus hallucis have recovered. This is not completed for months; meanwhile, the patient's weight, bearing on the weakened inner side of the ankle, together with the unopposed action of the calf and peronei muscles, may reproduce a very marked equinovalgus deformity. Whether by boots or when standing and walking, weight must be thrown upon the outer side of the foot so long as the structures on the inner side remain weak. When the deformity owing to malunion has become established, the results of operative interference are likely to be unsatisfactory, owing to the weakening of the outer as well as the inner side of the ankle. The normal mortise, permitting only of flexion and extension of the astragalus, is not restored. For the slighter cases described by the French surgeons, it may be questioned whether the restoration of the mortise would not have been more nearly accomplished if the tendo achillis and the peronei tendons had been first divided and then the foot wrenched inward and brought forward.

" The excision of the astragalus, or that with the removal of callus and fragments of the internal malleolus and posterior border of the tibia, was adopted in some cases, in others an osteotomy of the fibula or tibia or both. As to the former procedure, the result to be aimed at must be an ankylosis, so that the sole of the foot is on the ground. Movement between the tibia and os calcis after astragalectomy must

be unsatisfactory, owing to the tendency of lateral movement. Oste-
otomy can only be satisfactory when the foot is already ankylosed in
a correct position and the line of weight can be made to pass through
the long axis of the tibia.

"In the exceptional cases in which the astragalus is really dis-
placed upward, the first question is the saving of the limb from ampu-
tation and next the diagnosis of the injury by aid of the X-rays.
Reduction will then only take a third place and be carried out when
it appears that the circulation in the foot is sufficient. Fergusson and
Bryant found the astragalus firmly wedged between the tibia and
fibula, but the foot was in such a good position that the sole could be
placed flat on the ground. The displacement upward of the astra-
galus was left unreduced, and a firm, useful ankle was the result.
As for the cases illustrated by museum specimens, in which there is a
comminuted fracture of the fibula, a displacement of the astragalus
upward and backward external to the tibia, with the internal malle-
olus lying under the tibia, it would seem that the trial should be
made of gentle reduction, after tenotomy of the tendo achillis.
The circulation in the foot may be endangered by extensive opera-
tive interference."

MURPHY'S DESCRIPTION

Failure to secure a good result from treatment occurs more com-
monly in connection with a Pott's fracture, than with any other type
of fracture except a Colles. A Colles fracture more frequently re-
sults in a failure to restore normal conformation, but one not nearly
so detrimental to the comfort and service of the patient as is the
case of a Pott's fracture. I will show you why. First, however, in
order that we may grasp the nature, extent and purpose of
the work to be performed in reducing a Pott's fracture, it is essen-
tial that we understand the elements of a Pott's fracture from a
practical standpoint.

What is a Pott's fracture? A Pott's fracture is an eversion frac-
ture always, never an inversion fracture. What do we mean by an
eversion fracture? It is a fracture of the lower end of the fibula
that is produced by the foot turning outward when the injury is sus-
tained. What happens when the foot turns outward? The external
surface of the astragalus presses against the tip of the external
malleolus, and the fibula breaks primarily. If the interosseous liga-

ment is strong, the fibula breaks within the first 2½ inches above the tip of the external malleolus, otherwise only the tip of the fibula is broken off on a line with the tibio-astragaloid articulation. In a typical Pott's fracture the fibula breaks high up.
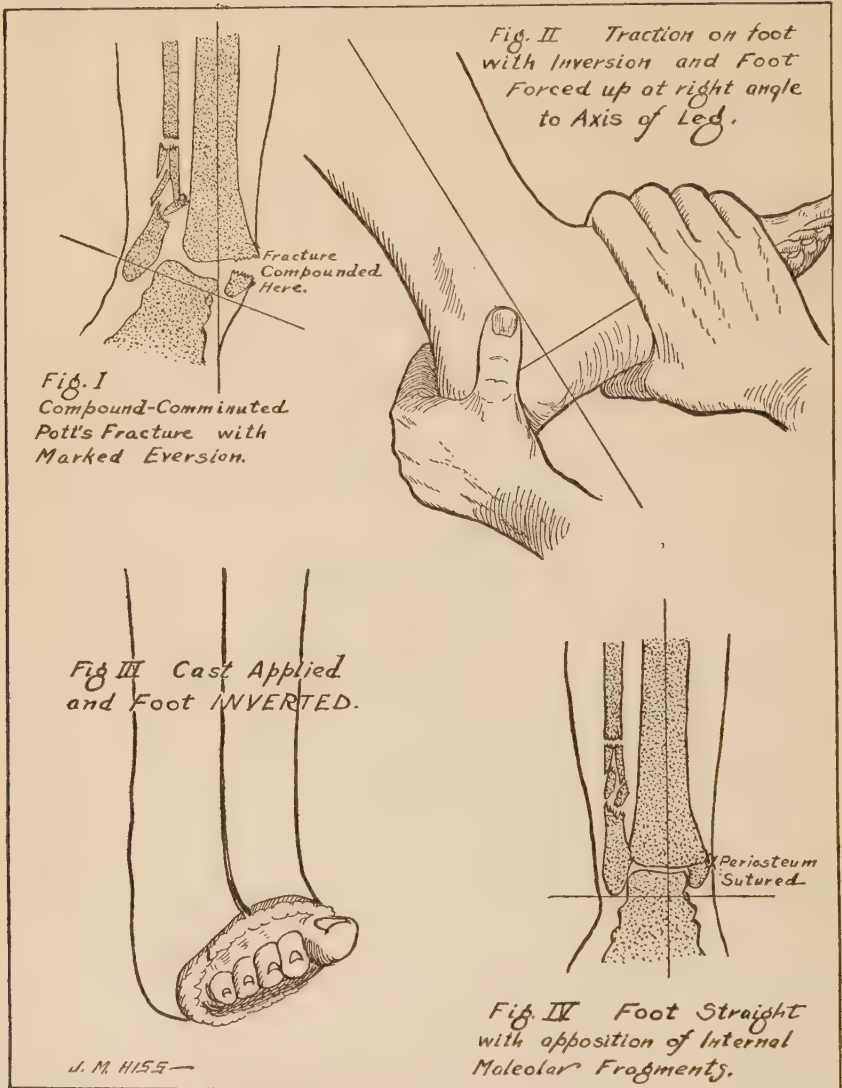
Next occurs a fracture of the internal malleolus, due to traction on the internal lateral ligament or rupture of the ligament. Then, as the pressure is continued with the foot everted and the weight of the patient's body is brought to bear on the foot, what happens? The astragalus is crowded up against the tibiofibular articulation, and, acting as a wedge, forces apart the tibia and fibula and splits or tears the interosseous ligament. If the force continues still further, anterior luxation of the tibia into the notch on the upper surface of the astragalus occurs, and the foot is not only everted but hyperextended. The variety of lesions and the amount of the deformity depend on the degree of eversion and the degree of force exerted. That is practically all there is to a Pott's fracture, unless the force is continued to the degree of compounding the fracture.

The next proposition to be considered is, how will you manage a Pott's fracture? That depends altogether on how the fracture is produced and what degree of bone and ligamental destruction has occurred and where. There are certain elements in the correction of a Pott's fracture that are vital to a favorable result. What are they?

First: The most dangerous and most serious complication in a Pott's fracture is an anterior luxation of the tibia on the astragalus. How can you ascertain the presence of an interior luxation of the tibia? The great prominence of the anterior margin of the articular surface of the tibia at the ankle is one point in diagnosis. Another is the backward luxation of the heel, so that the long axis of the tibia falls too far forward on the foot. The foot seems to be foreshortened. The skiagram is another aid in the diagnosis.

Second: If the tendo achillis is intact and you endeavor to bring the foot up to right angles or better, what happens? You cannot do it on account of the fixation of the tendo achillis and the forward luxation of the articular end of the tibia, which strikes the upper surface of the astragalus when flexion is attempted. Whenever, therefore, in a Pott's fracture it is impossible to bring the foot to a right or an acute angle with the leg anteriorly, you know you have an anterior luxation of the tibia. That is the proposition which you must bear in mind.

FIG. 21.

Fig. II   Traction on foot with Inversion and Foot Forced up at right angle to Axis of Leg.

Fig. I
Compound-Comminuted Pott's Fracture with Marked Eversion.

Fracture Compounded Here.

Fig III   Cast Applied and Foot INVERTED.

Periosteum Sutured

Fig. IV   Foot Straight with opposition of Internal Maleolar Fragments.

J. M. HISS—

Cast applied showing *extreme degree of inversion.*

What should you do to relieve the luxation? No amount of traction of the foot forward will pull the anterior margin of the tibia out of its bed in the notch of the astragalus. What can you do? Remember that every fracture is best reduced in inverse order of the

movements in its occurrence. Therefore, inasmuch as this luxation was the last step in the occurrence of this fracture, it is the first step to be overcome in effecting a reduction. Increase the deformity by extending the foot as far as possible, until it is almost on a parallel line with the tibia, then apply downward traction, and make a skid of the upper surface of the astragalus, so that when you flex the foot, the tibia easily slides back into position, and you will know that you have reduced the dislocation when you are able to flex the foot to an acute angle with the leg.

The next proposition is, how will you manage the fracture? Let us see what happens as this fracture occurs. The original accident resulted, first, in a fracture of the fibula; next a laceration of the interosseous ligament, the integrity of which, as far as the subsequent usefulness of the limb is concerned, is enormously more important to the ultimate result than to secure a union of the fibula. What do I mean? I mean that unless the torn interosseous ligament reunites, so as to secure a close contact of the tibia and fibula, the patient will have a permanent eversion of the foot. In failure of this close union the patient walks for five or six weeks after the accident with his foot fairly flat, but the eversion increases in degree until, after five or six months, he will be walking on his internal malleolus, that is, if there is not an accurate union of the torn interosseous ligament.

How will you insure a union of the interosseous ligament? By securing a perfect contacting of the normally contiguous surfaces of the tibia and fibula and maintaining the contact. How is that accomplished? By reducing the eversion of the foot. With the foot at an acute angle to the leg, adduct it as far as possible, make strong traction on it, and then push it as far to the inner side as you possibly can. Make a forced inversion. What prevents it from going too far? The fibula. An internal displacement is prevented by the pressure of the inner surface of the fibula against the tibia. In the ordinary Pott's fracture you cannot displace the foot too far inward. Retain it in that position, flexed on the leg, and adducted as much as possible. When the foot is not adducted sufficiently, the V-shaped upper surface of the astragalus is later driven up between the tibia and fibula, separating these bones and preventing close union of the interosseous ligament. A permanent eversion of the foot, continually increasing in degree, is the result.

In such cases we always put on a plaster-of-Paris cast, extending from the toes to the knee, making sure that there is no pressure on the external popliteal nerve as it winds around the neck of the fibula, because pressure on this nerve causes a subsequent drop-foot. The cast must be split as soon as it has hardened, to eliminate the possibility of pressure occurring subsequently as the tissues swell beneath the cast.

CONCLUSIONS

Pott's fractures are definite pathologic entities produced in a certain manner characterized by a typical deformity depending on the degree of force applied. They may consist of any of the following types:

First: A fracture of the fibula anywhere above the joint line up to $3\frac{1}{2}$ inches, usually about $2\frac{1}{2}$ inches above tip of external malleolus, just at top of triangle of the fibula.

Second: Fracture of internal malleolus.

Third: Fracture of fibula and internal malleolus.

Fourth: Fracture of fibula, internal malleolus and torn interosseous ligament with astragalus acting as a wedge, causing varying degrees of eversion.

Fifth: A fracture of fibula, a fracture of internal malleolus, torn interosseous ligament, tibia and fibula separated with eversion of foot and anterior luxation of tibia into notch of astragalus.

Sixth: Consists of the deformities enumerated under five with the addition of a compounding of a fracture.

Seventh: This type under the seventh division is known as an ancient Pott's fracture and may consist of any combination from the first to the sixth.

TREATMENT

How are we going to prevent the deformities and disabilities which we see?

First: By the proper handling and management of the primary fractures. This will be taken up under three heads:

1. SIMPLE FRACTURES.
2. COMPOUND FRACTURES.
3. ANCIENT FRACTURES.

1. *Simple Fractures.*—A proper diagnosis must be made, based upon an accurate history, a local examination determining exactly

FIG. 22.

Full length plaster-of-Paris cast. After it has been
split with a Gigli saw. Type of cast used in Pott's
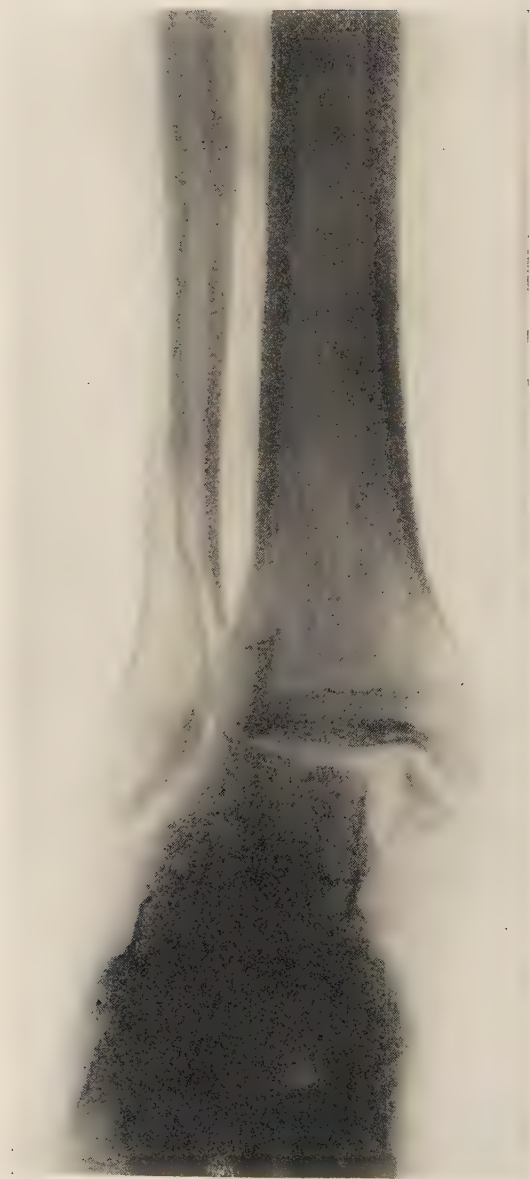fracture.

Fig. 23.

A primary compound comminuted Pott's fracture. Before
operation.

Fig. 24.

A compound comminuted Pott's fracture. Primary. After operation. Absorbable suture.

Fig. 25.

Ancient Pott's fracture six months after injury. Typical
deformity.

Fig. 26.

Ancient Pott's fracture after open operation six months after injury. Extra articular nailing. Silver wire around fibula, perfect result.

FIG. 27.

FIG. 28.

superlative degree showing ancient Pott's [frac]ture with all deformities, three years' dura[ti]on. 1, Fracture fibula, vicious union; 2, [Fr]acture internal malleolus; 3, Ruptured inter[o]sseous ligament; astragalus acts as a wedge.

Forcing tibia and fibula apart. 4, Anterior luxation tibia on astragalus; 5, A very rare fracture of external end of tibia; 6, Complete eversion of foot.

FIG. 29.
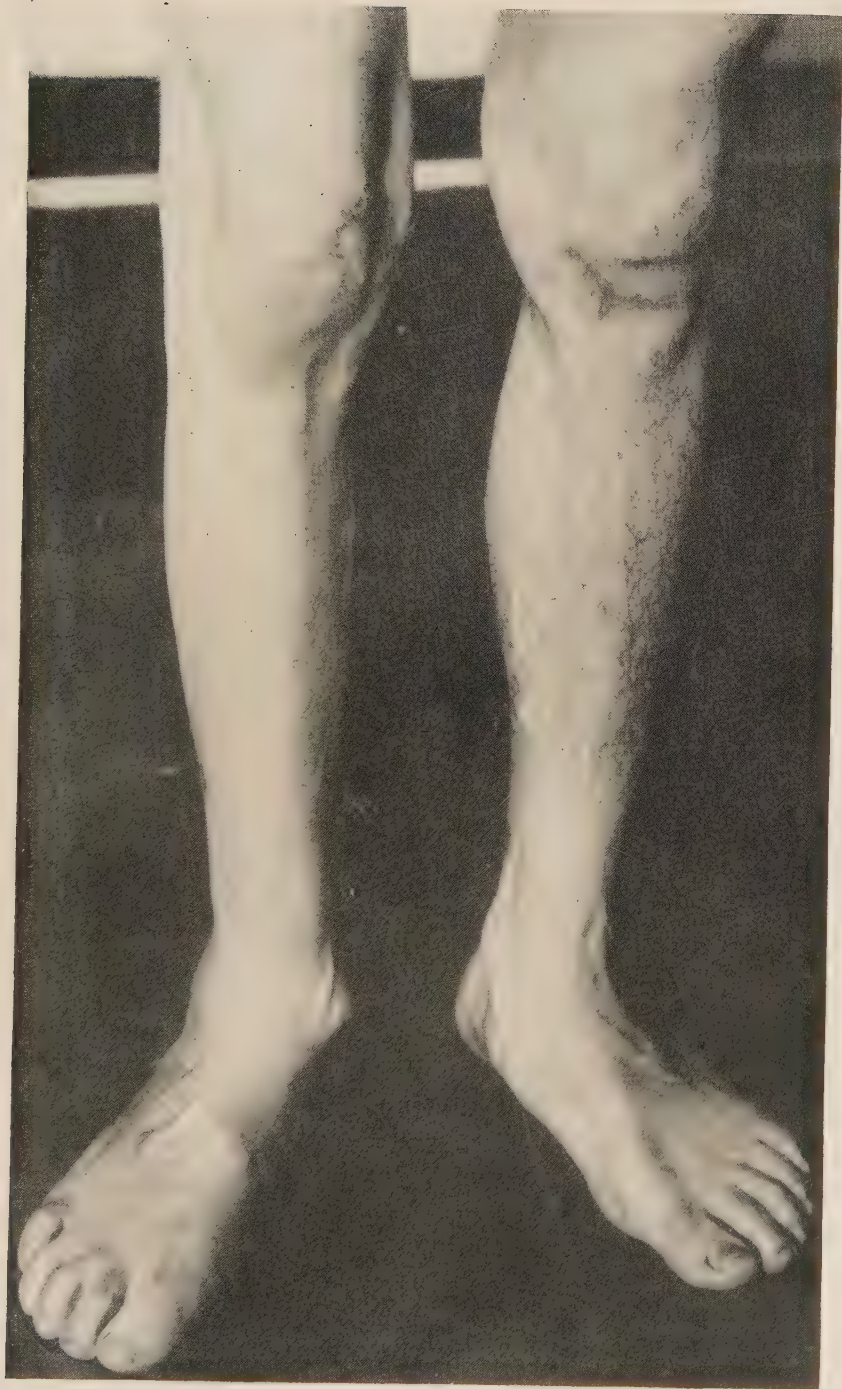
Showing typical deformity in ancient Pott's fracture.

the deformities present, backed up by at least two views, a lateral and an antero-posterior skiagram. Under general anæsthesia a proper reduction must be made, beginning with the last deformity produced, a reduction of the luxation of the tibia into the notch of the astragalus; this luxation is reduced by increasing the deformity until the foot is almost parallel to the tibia, downward traction is made so that a skid is made of the upper surface of the astragalus and the tibia slides back into position. When one is able to flex the foot at an acute angle with the leg, then you know a proper reduction of this luxation has been made. The foot is flexed at a right angle to the leg and complete inversion of the foot is made, which approximates the interosseous ligament, that is of the utmost importance in securing contact of the tibia and fibula, putting the parts in the best possible position for healing. Ordinarily one cannot turn the foot in an inversion too far, for the reason that the external lateral ligament is never torn and this position pushes the astragalus internally under the tibia in its proper position, the plumb line between the astragalus and tibia being correct and further approximate the internal lateral ligament if it be torn or the fractured internal malleolus to the tibia. A plaster-of-Paris cast is put on with the limb in this position and worn for a period of at least eight weeks, and it should be at least three months before the patient is allowed to bear any weight at all upon this type of fracture. After the cast is applied, we split this by means of a Gigli saw or plaster knife from the toes to the knee, to eliminate swelling and œdema and the possibility of an acute myositis, the result of constriction. If this treatment is properly carried out with a correct reduction of the deformity and the patient is kept off of the limb for a period of three months, one will practically always secure a good result.

2. *Compound Fractures.*—If this fracture has been compounded, a most careful attention to the details of asepsis and technic must be made. *No foreign bodies are ever permitted in the treatment of any of our compound fractures.* If an operation is to be performed, iodine is the antiseptic of choice. A suture can be made of the periostium and ligaments, if necessary, the suture being an *absorbable one.* After a proper debridement, if necessary, an accurate closure can be made without drainage. If infection follows, Carrol-Dakin solution can be used and the proper position maintained with fixation.

3. *Ancient Pott's Fracture.*—In speaking of operation in ancient

Pott's fracture, this is one of the most difficult surgical procedures that we have to contend with. If the anterior luxation is present, there is always a *danger* of gangrene of the toes and foot, following reduction due to stretching and pressure of the vessels. The first incision is made externally over the fibula. There is practically always a malunion or a vicious-union of the fibula. This union is refractured, the bone of the proximal and distal fragments chiseled or curretted down to good bone and an incision made over the lower end of the tibia and the tip of the internal malleolus after being freshened, is nailed to the tibia, with an ordinary wire nail. The periostium and ligament is sutured over this. The foot is fixed in complete *inversion* after the fibula has been wired or plated. The incisions are closed without drainage and a cast is applied from the toes to the knee with *the foot dressed in complete inversion for a period of eight weeks.*

If these procedures, namely, one and two, are properly carried out, we will have very few ancient Pott's fractures to operate upon. I have tried in this brief article to review Pott's fracture, showing the exact etiology as well as the pathology present and the proper method of procedure in the handling, management and treatment of this class of cases, and I feel that the period of disability will be greatly reduced, we will have less deformities and a great decrease in the number of cripples, as well as a lessened amount of secondary operations with more satisfied and grateful patients, as well as a great personal satisfaction among industrial physicians and surgeons, who handle this condition known as Pott's fracture.

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STERILIZATION

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THERE has been within the last twenty-five years a great social awakening to the fact of racial degeneracy. The public mind is beginning to ask why there are so many insane, epileptic, feeble-minded, criminals and paupers. An International Eugenic Congress was held at the University of London, England, from July 24 to July 30, 1912. This notable gathering took place eight years after Sir Francis Galton had given to the world his outline of the science of eugenics. It has been estimated by an eminent authority that at the present time there are in the United States:

           42 institutions for the feeble-minded,
          115 schools for the deaf and blind,
          350 hospitals for the insane,
        1,200 refuge homes,
        1,300 jails and prisons,
        1,500 hospitals,
        2,500 almshouses,
       23,000 juvenile delinquents in institutions
      100,000 blind,
      100,000 criminals,
      100,000 deaf and dumb,
      100,000 paupers in almshouses,
      300,000 insane and feeble-minded.

This same authority estimates that two-thirds of these defective individuals are parents of defective children. These figures are in themselves appalling.

It has been, and is, the purpose of eugenics to acquaint society with the great prevalence of racial defectiveness. It has been the claim of the eugenists that this vast amount of degeneracy is due largely to hereditary transmission, and the careful study of clinical facts has borne out this contention. It is at once admitted that all this disease, defect and crime is not due to heredity. Vicious environment plays an important part in the production of degeneracy.

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Man is a creature of two great forces—heredity and environment. They cannot be separated nor intelligently considered apart. It is meant by heredity that man has passed on to him certain potentialities and diseases which environment through nurture and education may greatly develop. Good heredity can accomplish but little without the influence of environment which may shape and modify inborn tendencies; but environment can never produce mental capacities. Man may be compared to a bullet which has behind it a certain charge of powder. The direction of this bullet, when fired, may in some degree be determined, but the bullet will never go beyond the range of power of the original charge of powder. A horse tied to a tether is at liberty to move within the limits of the rope that holds him, but he cannot go further. So it is with man. These two homely analogies illustrate the force of heredity.

Punnett, in his book on Mendelism, frequently points out the relationship between heredity and environment: " Education is to man what manure is to the pea. The educated are in themselves the better for it, but their experiences will alter not one jot the irrevocable nature of their offspring. Permanent progress is a question of breeding rather than of pedagogics; a matter of gametes, not of training. As our knowledge of heredity clears and the mists of superstition are dispelled, there grows upon us with ever-increasing and relentless force the conviction that the creature is not made, but born." A superficial veneer of culture brought about by training and environment cannot long hide organic defect. The degenerate, the feeble-minded and the imbecile will remain as they are, no matter how much we do for them. This is the experience of all superintendents of institutions for feeble-minded.

After a long, careful study of feeble-mindedness, Goddard has come to the conclusion that no less than two-thirds of all feeble-mindedness is due to heredity. The experiences and studies of numerous other investigators have led them to entirely agree with him in his conclusion. Various family histories have been traced and compiled, and they show, beyond a question of a doubt, the fact that mental defectiveness is transmitted from parent to offspring. Among the most striking of these degenerate genealogical trees which have been charted are the Juke Family, by Dugdale; Kallikak Family, by Goddard; Zero Family, by Jorger, and the Tribe of Ishmael, by

McCullouch. Doctor Bahr, of Pennsylvania, forcefully states: " The family histories collated in the institutions and hospitals of our land form in themselves a library of tragedies which would convince the most skeptical of the magnitude of race suicide, increasing with each generation. * * * In my individual study of four thousand and fifty cases of imbecility I fine two thousand, six hundred and fifty-one, or 65.45 per cent., caused by malign heredities; and of these one thousand and thirty, or 25.43 per cent., are due to a direct inheritance of idiocy, and two hundred and eighty, or 6.91 per cent., to insanity."

It has been agreed by the most prominent alienists that many forms of nervous and mental diseases are hereditary—among these disorders are chorea, manic-depressive insanity, dementia præcox, epilepsy and feeble-mindedness. It has also been shown that a neuropathic constitution which renders individuals susceptible to acute mental diseases, is also an inheritable condition. The truth of these two statements has been so emphatically established that there is no need of further discussion just here to elucidate this matter. Since it has been demonstrated that physical qualities and degeneracy are transmitted from parent to offspring, biologists and physicians have sought to formulate theories which would explain the mechanism of heredity. Various hypotheses have been advanced to explain this phenomenon, and most prominent among them are the following:

> Spencer's Physiological Units,
> Darwin's Pangenesis,
> Galton's Stirp Theory,
> Weismann's Germ Plasm,
> Lamarck's Theory of Inherited Characteristics,
> Mendelian Hypothesis.

None of these theories need be mentioned in this article except those of Mendel. In fact, most of them are no longer supported by biologists. It will be well to speak of the last one, however, since the Mendelian theory comes nearest to explaining the heredity of man than any other.

" As a result of the experimental study of variation and heredity, Mendel found that on crossing the tall and dwarf varieties of plants the next generation consists of only tall plants. Let us, therefore, call tall ' dominant ' (designated by D) and dwarf ' recessive ' (designated by R). When these cross-bred plants fertilize themselves in

the next generation there result tall and dwarf plants in the proportion of approximately three tall to one dwarf. The recessive dwarfs, when self-fertilized, produce only dwarfs for any number of generations—they are pure recessives. The dominants (tall), when self-fertilized, produce one-third pure dominants (which on self-fertilization produce only dominants for any number of generations) and two-thirds cross-bred dominants which are impure or hybrids. In other words, there are one-fourth pure dominant, two-fourths impure dominant or hybrid, and one-fourth pure recessive. The hybrids, when self-fertilized, again produce pure dominant, impure dominant or hybrid, and pure recessive in the ratio of one, two and one. This is represented diagrammatically in Fig. 1. * * *

" The facts of variation and heredity have been proven for all forms of life other than man. In the case of plants and animals new races can be built up to order. Man can create and establish new and valuable varieties. Wheat can now be made to order. A variety of wheat has been produced, combining some valuable trait from several varieties. Special kinds of cotton, of corn, and of sheep can be obtained—pure varieties breeding true. So it is throughout the plant and lower animal kingdoms. Do these laws apply to man?

" Although we cannot experiment with man or definitely control his actions in any respect, especially in the matter of mating, we can observe experiments made at random by nature on man. We can keep records of our observations, tabulate and measure the results. Thus the knowledge of human heredity is largely of the statistical sort.

" In what human characters has Mendelian inheritance already been proven? The most clearly established Mendelian character in man is eye-color, in which brown is dominant over blue, owing to the presence or absence of pigment on the interior surface of the iris. We may also enumerate the following, which seem to follow Mendelian lines: color-blindness, hair color and curliness, albinism, brachydactylism, syndactylism, polydactylism, keratosis, hæmophilia, congenital stationary night blindness, certain forms of deaf-mutism and cataract, and Huntington's chorea. Pathological traits seem in the main to be dominant. Retinitis pigmentosa, albinism and alkaptonuria seem to be recessive. Hæmophilia is peculiarly ' sex-limited,' being dominant in the male and recessive in the female, and is, therefore, transmitted through the female, but affects the male."

FIG. 1.

$$D \times R$$

$$[D]$$

D   [D]   R

D   D[D][D]R D[D][D]R   D
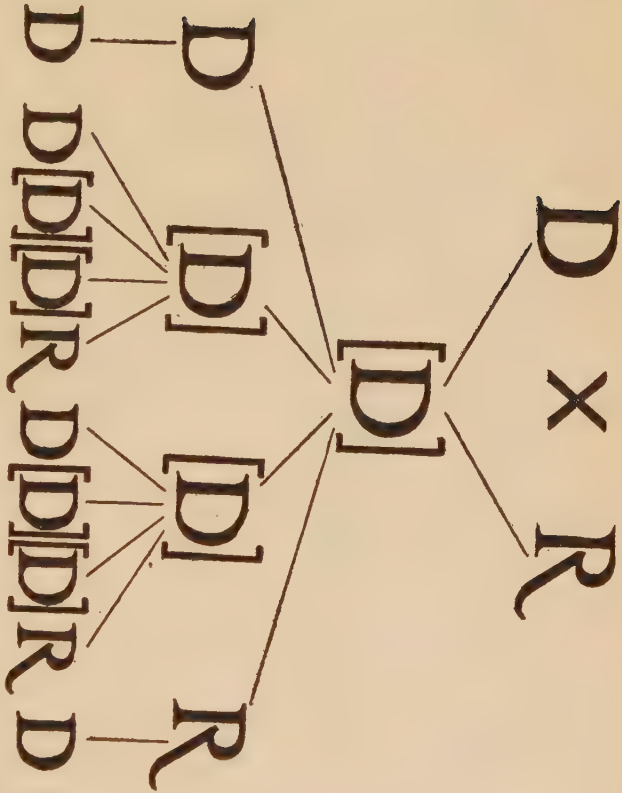
Mendelian inheritance in peas. D, tall plant of pure strain; R, dwarf plant of pure strain; [D], tall plant in which the dwarf character is latent; [D] plants when self-fertilized produced plants in the following proportions: 1 D, 2 [D], 1 R. (After Punnett.)

In accordance with the general principles of the Mendelian hypothesis, it would be quite possible to foretell the character of the progeny of certain matings. The accompanying chart indicates the various unions and their offspring. The squares represent males; the circles, females; a white square or circle represents a normal individual; a solid black circle or square represents a defective individual; a half black square or circle indicates a neuropathic individual capable of transmitting neuropathic tendencies. (See Fig. 2.)

CHART NO. 2

I. Both parents normal, all the children will be normal.

II. Both parents defective, all the children will be defective.

III. One parent being normal, but with a neuropathic taint from one grandparent, and the other parent defective, half of the children will be apparently normal, but capable of transmitting the neuropathic constitution to their offspring, and half will be neuropathic.

IV. One parent being normal and of pure normal ancestry, and the other parent neuropathic, all of the children will be apparently normal but capable of transmitting the neuropathic constitution to their offspring.

V. Both parents being normal, but each with a neuropathic taint from one grandparent, one-fourth of the children will be normal and not capable of transmitting the neuropathic constitution to their offspring; one-half will be apparently normal but capable of transmitting the neuropathic constitution to their offspring, and the remaining one-fourth will be defective.

VI. One parent being normal and of pure normal ancestry, and the other parent apparently normal but with a neuropathic taint from one grandparent, half of the children will be normal and incapable of transmitting the neuropathic constitution to their offspring, and one-half will be apparently normal but capable of transmitting the neuropathic constitution to their offspring.

The statistical tables of our state institutions show that there is a strikingly close relationship between these Mendelian tables and the actual findings in heredity.

The whole mass of statistical evidence which has been gathered from the records of our hospitals for the insane, schools for the feebleminded, colonies for the epileptic, and other eleemosynary institu-

Fig. 2.

·MENDELIAN·INHERITANCE·CHART·
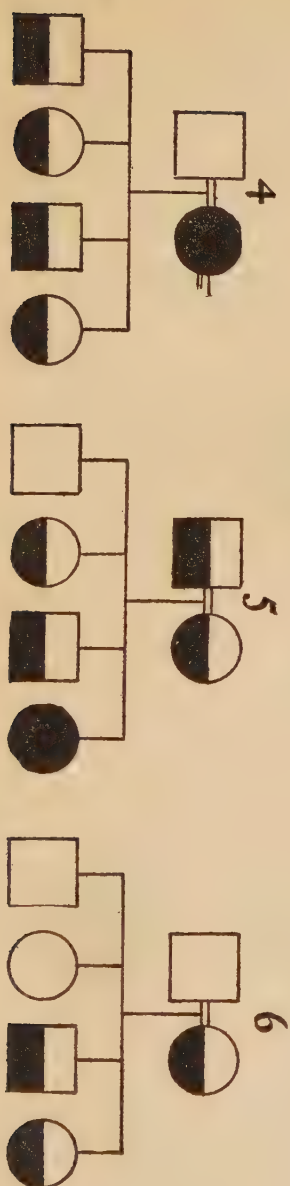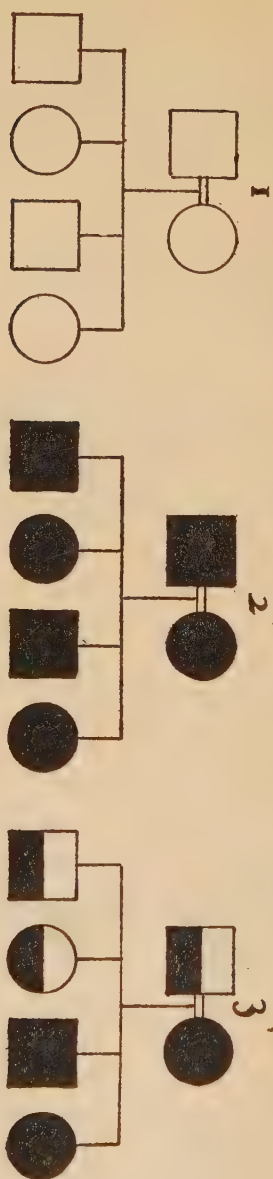
tions conclusively proves that mental defectiveness is hereditary and that tendencies to defectiveness are likewise inherited. There need be no quibbling about the ultra-scientific theories of heredity and racial poisons which affect the germ plasm, or about the differences between congenital heredity and direct heredity. The syphilitic parents always bear syphilitic children as the Wassermann test will

Fig. 3.

MENDELISM (AFTER THOMSON)
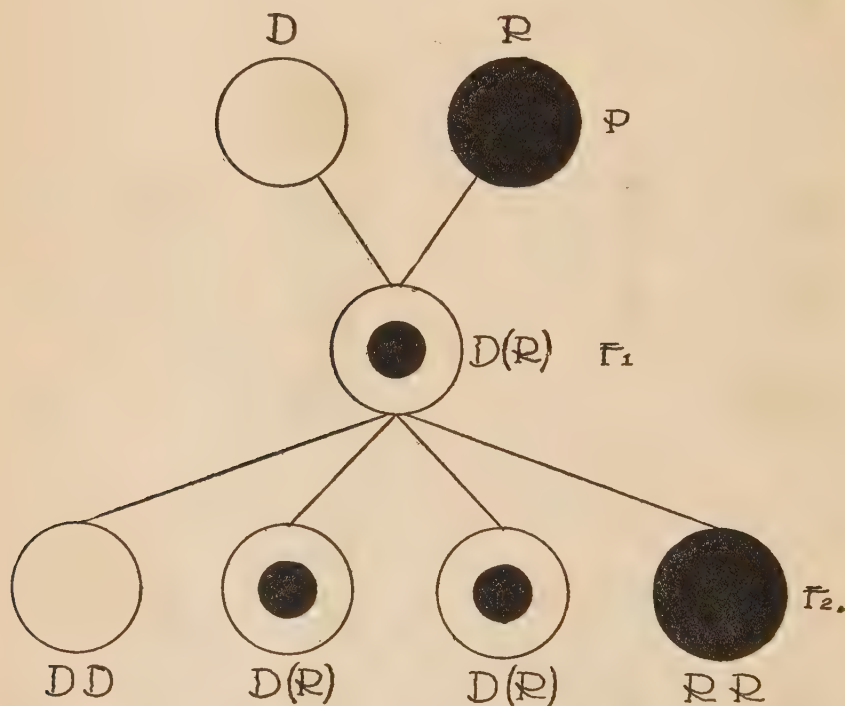
show and never has it been known for two mentally defective individuals to become the parents of a normal child. The data that I have been able to gather after a personal examination of more than five thousand prisoners has shown that the antecedents of 44 per cent. of these convicts were psychopathic individuals who were either insane, feeble-minded, epileptic, criminal or suffered with organic or functional diseases of the nervous system. It is still a disputed ques-

tion as to whether crime is directly inherited or not. Criminologists are about evenly divided on this question, though the burden of the proof is with those who say that it is. But it can be said with scientific exactness that crime is indirectly inherited, because mental defectiveness is inherited, and this condition produces a susceptibility which leads to criminal acts. The individuals who are unstable because of

Fig. 4.

MENDELISM (AFTER THOMSON)
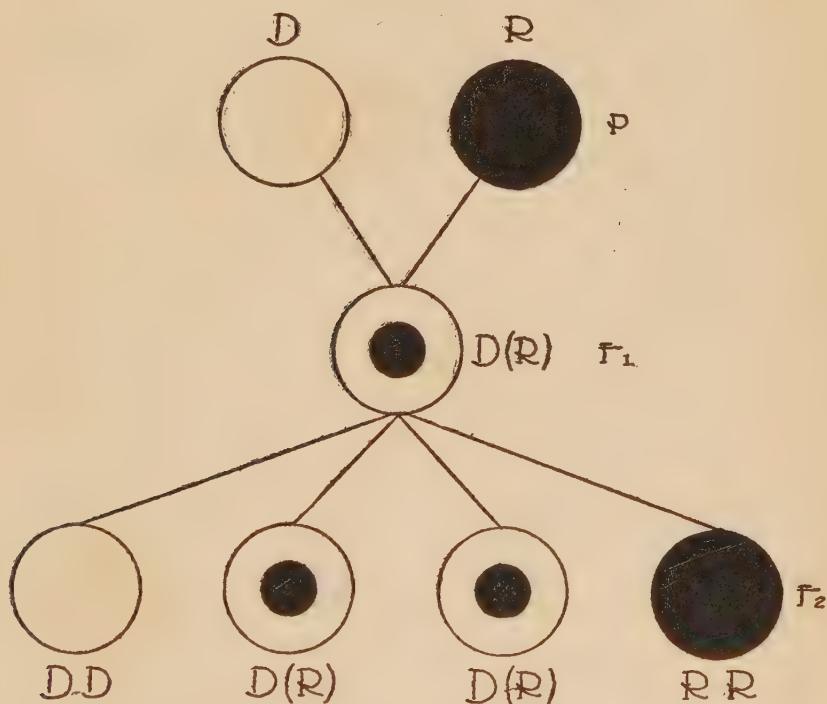
defective nervous systems find it exceedingly difficult to adjust themselves to the normal order of human society. They are even unfitted to acquire the education which will enable them to live without crime, because of their constitutional inferiority. They soon gravitate to the lowest levels of society; they are excluded from the realms of legitimate industry and sooner or later they inevitably fall into the practice of crime or mendicancy.

It is at once apparent to the student of social and criminological affairs that if we are ever to get rid of criminals we must cease breeding mental defectives who become criminals. There are three remedies which society has at her command to use, which we may classify under the term negative eugenics; these measures are: restriction of marriage, segregation and sterilization of the defectives, dependents and delinquents during the child-bearing period. The first two will not be discussed, but the third remedy will be considered.

Sterilization is not by any means a modern idea or practice; this measure was in force in ancient times among the Hebrews and the Egyptians. It was practiced many years ago among the inhabitants of the South Sea Islands and among the American Indians. The insane, idiotic, epileptic, leprous, or those afflicted with transmissible disease were sterilized in Scotland, according to Bœtius, who said: "He was instantly gelded, and if a woman, she was kept from all intercourse with men."

Castration was first advocated in America nearly fifty years ago by Dr. Gideon Lincecum before the Texas State Legislature as a substitute for the death penalty. His suggestion was not very enthusiastically received by this deliberative body. The ridicule which marked its reception then has given place, as the years have gone by, to serious study and investigation by eugenists. At last, when the public had been sufficiently enlightened and our legislators somewhat educated, a law was enacted in the state of Indiana in 1907 through the efforts of Doctor Sharp for the sterilization of the confirmed criminals, idiots, imbeciles and rapists. Since that time other states have followed suit and among them is Iowa, New Jersey, California, Washington, Connecticut, New York, Utah, Nebraska, and several other states. Bills authorizing sterilization have been introduced into other state legislatures, but they have failed to pass.

A summary of these sterilization laws was published in a recent issue of the *Journal of Criminal Law and Criminology* as follows:

"Indiana provides, as a board of examiners who shall decide upon whom to operate, two expert physicians and superintendents and boards of managers of institutions where such persons are confined.

"The operation may be applied to confirmed criminals, idiots, imbeciles and rapists.

"Several hundred operations have been done in this state.

" Iowa provides, as a board of examiners who shall decide upon whom to operate, the managing officer of the state institution where such persons are confined, the members of the state board of parole, and the surgical consultant of such institution.

" The operation may be applied to habitual criminals, idiots, feeble-minded, imbeciles, drunkards, drug fiends, epileptics and syphilitics. The operation applies to both men and women.

" New Jersey provides that the governor shall, with the advice of the senate, appoint a surgeon and a neurologist, each of recognized ability, for a five-year period, who, with the commission of charities, and the superintendent of the institution shall constitute a board of examiners which shall decide upon whom to operate.

" The operation may be applied to confirmed criminals, feeble-minded, epileptics and other defectives. Only those who cannot recover and where procreation is not advisable may be operated upon, and only after five days' notice by the board to the court of common pleas in the county. It is lawful for any competent surgeon to operate.

" California provides that the superintendent of a state hospital for insane, the superintendent of a home for feeble-minded, or the resident physician of the state prison, when in their opinion it would be beneficial and conducive to the benefit of the physical, mental and moral condition of any inmate of said hospitals, home, or state prison, to be asexualized, shall call the general superintendent of state hospitals and the secretary of the state board of health, and if two of the three examiners favor the operation, it may be performed on inmate, patient or convict.

" Washington provides that whenever any person shall be adjudged guilty of carnal abuse of a female person under the age of ten years, or of rape, or shall be adjudged to be an habitual criminal, the court may, in addition to such other punishment or confinement as may be imposed, direct an operation to be performed upon such person for the prevention of procreation.

" Connecticut provides that the directors of the state prison and the superintendents of the state hospitals for the insane are directed to appoint for each of said institutions, respectively, two skilled surgeons, who, in conjunction with the physicians or surgeon in charge at each of said institutions, shall constitute the board of examiners. A majority of the board rules.

" The law may be applied to both men and women who would be liable to produce children with an inherited tendency to crime, insanity, feeble-mindedness, idiocy or imbecility.

" New York provides that the governor shall appoint for a term of five years one surgeon, one neurologist, and one practitioner of medicine, each of ten years' experience, who shall constitute the board of examiners.

" The law applies to feeble-minded, epileptics, criminals and other defective inmates confined in the several state institutions. Counsel must be appointed for the persons to be operated upon, and no operation must be performed until five days after the order of the board has been filed with the clerk of the court and a copy served upon the counsel appointed to represent the person examined. All orders made by the board are subject to review by the supreme court. A complete record must be kept by the institution where the inmate is confined.

" Utah has also passed a law similar to those cited. In most of these laws, provision is made for severe penalties for those who perform the required operation for improper purposes.

" Governor Sheldon, of Nebraska, in his message to the legislature in 1909, recommended the careful consideration of the necessity for passing a law to prevent the marriage of persons unfit to propagate and also a law for the sterilization of defectives.

" In Illinois, Pennsylvania, Oregon, Texas, Wisconsin and Oklahoma bills have been introduced for preventing increase in defectives, but have failed of enactment."

The sterilization laws for the most part are not as carefully and thoroughly written as they should be. Too many of them contain statements about heredity that are not yet proven; others have stated that sterilization was for the purpose of punishment. These defects in the law have been a source of criticism and have been the reason for their repeal in several instances. If the state legislatures would enact statutes overcoming these mentioned defects, the propaganda against sterilization would in a large measure cease.

Recognizing the need for such a law the Eugenics Record Office has drafted one to serve as a model; it reads as follows:

" AN ACT to prevent the procreation of feeble-minded, insane, epileptic, inebriate, criminalistic and other degenerate persons by authorizing and providing by due process of law for the sterilization

of persons with inferior hereditary potentialities, maintained wholly or in part by public expense.

" BE IT ENACTED BY THE PEOPLE OF THE STATE OF ———.

" Section 1. There is hereby established for the state of ———, a Eugenics Commission, whose duties are hereinafter defined, and which shall be composed of three persons possessing respectively expert knowledge in biology, pathology and psychology.

" Section 2. Immediately after the passage of this act the governor (or State Board of Control) shall appoint the members of the Eugenics Commission, one of whom he (or said State Board of Control) shall designate as chairman. Any determination or order concurred in by two members of the commission shall be deemed an order of the commission. The members of the commission shall hold office at the pleasure of the governor (or State Board of Control), and vacancies in the commission shall be filled by him (or by the said board) as they occur. Immediately after their appointment the commission shall assemble, shall organize their body and shall proceed to carry out the provisions of this act. The members of the Eugenics Commission shall be required to devote their entire time and attention to their duties as herein contemplated, and for their services shall be compensated from state funds not otherwise appropriated; and for the performance of their duties as herein contemplated, the aforesaid commission shall be directly responsible to the governer (or state Board of Control).

" Section 3. It shall be the duty of the Eugenics Commission to examine into the innate traits, the mental and physical conditions, the personal records, and the family traits and histories of all prisoners, inmates, and patients of all the state and county institutions for the insane, the feeble-minded, the epileptic, the inebriate, the criminalistic and pauper classes, and of all individuals of such classes in private institutions supported in whole or in part by state funds, excepting always permanent custodial cases, with the view to determining whether in each particular case the individual is a person potential to producing offspring who, because of the inheritance of inferior or anti-social traits, would probably become a social menace, or a ward of the state. If after such investigation the commission is of the opinion that a given inmate is a person potential to producing such offspring, it shall be the duty of the commission to report its

findings and to recommend an appropriate type of sterilization opera-
tion to (state court of record of competent jurisdiction) at least thirty
(30) days before the day set for the release of such persons from the
custody of the state.

" Section 4. The aforesaid court shall thereupon set a day for
hearing the facts of the case, and shall immediately order that either
the persons nominated for the operation, his nearest kin, lawful
guardian or close friend, be notified forthwith in writing of the time,
place and nature of the aforesaid hearing; provided that in cases where-
in on account of the mental or physical conditions of the person so
nominated, such notification would, in the opinion of the commission,
be inadvisable, and wherein, in the same case, the whereabouts of
neither the aforesaid mentioned nearest of kin, lawful guardian, nor
close friend within the state be known to the commission, it shall be
sufficient for said commission to indorse the notification statement
with a statement of the reasons why such notification was not served.

" Section 5. On the date previously set for the hearing as herein
contemplated, the aforesaid court shall, with all speed consistent with
thoroughness, examine the findings and recommendations of the com-
mission, and shall hear any objections that may be offered thereto.
The commission shall be represented at the hearing by the (proper
state or county attorney), and shall defend their recommendation,
and in all subsequent litigation incident to the execution of their
duties as herein contemplated, the commission shall have the services
of the (said proper state or county attorney). The court may at its
discretion appoint counsel to represent the person nominated for
sterilization, and shall fix the compensation for such services, which
compensation shall be paid from the funds from which other similar
court expenses are now paid. If, after due consideration, the court
is satisfied that the individual prisoner, inmate, or patient nominated
for sterilization is a person as found by the commission, namely, one
who is potential to reproducing offspring who would probably, because
of the inheritance of inferior or anti-social traits, become a social
menace, or a ward of the state, it shall be lawful and it shall be the
duty of the aforesaid court to authorize and to order the Eugenics
Commission to order the responsive head of the institution, in whose
charge the particular persons nominated for sterilization may be,
to cause to be performed on such person, in a safe and humane manner,

before his or her discharge or release from the custody of the state, an operation for the prevention of begetting or of conception, as the case may be; and the type of operation may be made a part of the order of the commission in each case; provided that said operation shall not be had within five days after the giving of the order therefor; and the aforementioned responsible head of the institution in whose custody the person subject to a particular order for sterilization may be, shall be directly responsible to the Eugenics Commission for the execution of the operation as ordered.

"Section 6. In case of a decision by the court contrary to the recommendations of the Eugenics Commission, said commission may, at its own discretion, order an appeal to (state court of competent jurisdiction), and the execution of any such original order for sterilization as herein provided for may be suspended by any judge of (court of competent jurisdiction) in the county in which the particular prison, inmate or patient may be confined, until the hearing and determination of objections to the said order, which hearing shall be had not later than the next special term for motions of the court, and an appeal will lie from the determination of such objections as from an order in a special proceeding. Pending the final determination of such a suspended order or of an appeal by the commission, the subject of the particular order for sterilization shall remain in the custody of the state.

"Section 7. After ordering the operation as hereinbefore provided for, any such operation may be performed by any skilled surgeon licensed in the state, who may be designated by the responsible custodian of the person ordered sterilized, and any expenses incurred by the operation shall be borne by the institution in whose custody the person sterilized may be. The aforesaid order shall constitute complete authority for the performance of said operation, and no skilled surgeon, duly licensed in the state, performing the same, shall be questioned in any place or held responsible for the performance of the same.

"Section 8. It shall be the duty of the managing head of all the state and private institutions subject to the provisions of this act to coöperate with the Eugenics Commission in their execution of their duties as herein contemplated, and to secure appropriate data concerning innate traits, personal records, and family histories and traits of

the prisoners, inmates or patients of their respective institutions subject to the provisions of this act, and to furnish said data to the Eugenics Commission at least 60 days before the date set for the release of each particular inmate.

" Section 9. The Eugenics Commission shall have full authority to make further study of the personal and family histories of persons subject to the provisions of this law furnished as herein contemplated by the managing heads of institutions; and in the prosecution of such investigations the commission shall have the right to summon persons and to administer oaths, and shall have free access to all court and institution records of this state likely to be of service to such investigations.

" Section 10. It shall be the duty of the Eugenics Commission to keep a permanent record of all business transacted by them, including a record of all cases, and histories examined into, and of all reports and recommendations made by them, and of all orders made and received by them, and annually to report a history of all such transactions to the governor (or state Board of Control).

" Section 11. All records of investigations, examinations, reports, recommendations, orders and personal and family histories made, entered, or secured by the commission are hereby declared to be the property of the state, and shall not be opened to public inspection except upon an order made by a judge of a court of record; provided, however, that all such records may be used for scientific study by the commission."

The policy of sterilization has had many warm advocates and supporters, and among them have been individuals who have commanded the public confidence. It has also had many enemies and opponents who were loud in their denunciation of this humane measure. The following individuals have supported this theory of sterilization: Doctor Barr, Chief Physician, Pennsylvania Training School for Feeble-minded Children, of Elwyn, Pa., says: " Let asexualization be once legalized, not as a penalty for crime, but as a remedial measure preventing crime and tending to future comfort and happiness of the defective; let the practice become common for young children immediately on being adjudged defective, by competent authority properly appointed, and the public mind will accept it as an effective means

of race preservation. It would come to be regarded, just as quarantine, a simple protection against ill."

Dr. Charles V. Carrington, of Virginia, remarks as follows: " Our juvenile courts, reformatories, probation officers, societies for aid to the discharged convicts—all are doing splendid work. Prevention is practically their motto, and is the motto of every person interested in the handling of criminals. After ten years of investigation as prison surgeon, and during that time seeing and treating thousands of our criminals, black and white, I am unreservedly of the opinion that sterilization of our habitual criminals is a proper measure."

The Committee on Criminal Law Reform of the National Prison Association says in its report of 1907 : " A further measure calculated to minimize the cause of the race problem will be found in statutes providing that in prosecutions for rape, assault with intent, incest and sodomy, the jury trying the issue shall have the power to specify sterilization of the defendant, in addition to the penalties for such crimes now prescribed."

Huxley is quoted to have said of sterilization the following: " We are sorry for you ; we will do our best for you (and in so doing we elevate ourselves, since mercy blesses him that gives and him that takes), but we deny you the right to parenthood. You may live but you must not propagate."

Quite a few objections have been offered against sterilization, chiefly by lawyers, clergymen and by some social workers and physicians. Many of the arguments of the attorneys have been facetious and merely a play on words to display their casuistic abilities. Medicine has ever been on the frontiers of science, an eternal proselyter for reform and progress ; the law has always lurked behind in the rear-guard of yesterday, finally reaching the milestones of scientific advance, which have been set by medical science. The first objection raised by the legal profession is that sterilization laws are unconstitutional, and that they interfere with personal rights. This has always been their shibboleth ; the same hue and cry was raised when the medical profession first sought to establish quarantine for contagious diseases. Some attorneys still fight vaccination in our courts even though they have been secretly vaccinated. When infected and poisonous milk was emptied into the sewers instead of allowing unscrupulous milk dealers to sell it to infant children, the lawyers brought the

Health Board of a certain large city into the courts because the health officers had interfered with " personal rights." The social workers, however, have some encouragement to persist in their efforts to better humanity for the majority of lawyers have at last awakened to the fact that the just-mentioned measures were rightful and legitimate. Some lawyers have insisted that certain defective individuals have the right to pollute and curse the race merely that the " rights " of the individual may be maintained. They have insisted that the incurable syphilitic must be permitted to infuse his vile poisons into an unpolluted family merely because he can purchase a marriage license certificate. They have advanced another argument that sterilization is a " cruel and unusual punishment." It is to be admitted that some of the sterilization laws were so framed as to lead to this erroneous view. Sterilization was never intended to be a punishment; it was devised for social relief and for the welfare of generations yet unborn. It is an effort to decrease the number of dependents, defectives and delinquents of future society, and our profound legal brothers should take a broad view of the question instead of seeking for a hair-splitting technicality to render such laws unconstitutional. They will be doing humanity a great service if they see that the sterilization laws are so framed as to be constitutional; they might in the spirit of progress aid in perfecting these laws. Legs are amputated, appendices and gall-stones are removed from suffering state wards, and we should have the same moral right to do some social surgery for the good of society.

Laws have been framed by attorneys to put individuals into prison; to hang and electrocute certain others; there seems to be no constitutional barrier to these proceedings, and yet I am sure some persons would regard them as interference with personal rights.

Sterilization has been condemned by many theologians, and this is not at all strange, for the clergy has ever been slow to accept the advancements of science, no matter whether the field be in physics, biology, medicine or sociology. This may be due to extreme conservatism or to the fancied interference that science might have with certain religious dogmas. The church once forbade dissection by physicians and medical students, and yet at the same time it tore the cringing human flesh with instruments of torture to wring from a mortal a recantation or a confession of faith. When Harvey discovered that

the blood circulated in the body he was promptly excommunicated from the English church. When Galileo discovered that the world revolved around the sun, he was thrown into a prison by the church. It is quite remarkable, however, that this is the case in matters of heredity, since the Bible contains many references to heredity. In the Pentateuch we find the statement that " the sins of the fathers shall be visited on the children even to the third and fourth generations." Jacob displayed his knowledge of heredity in the breeding of his cattle and sheep when he swindled his father-in-law, Laban, out of the herds. Jacob knew enough about the practical workings of heredity to select the dominant male animals and left the recessive males to Laban, and the Scripture records that Jacob became very rich because of his wily dealing in cattle. Christ said in His Sermon on the Mount, " By their fruits ye shall know them. Do men gather grapes from thorns or figs from thistles ? " One of the fundamentals of the Christian religion is the doctrine of the inheritance of original sin. " Through Adam all men have sinned." Likewise in the Scriptures we find that men have been made eunuchs for the kingdom of heaven's sake; and for excellent reasons some individuals should be made eunuchs for the sake of humanity.

Bishop Sumner, of Oregon, takes the scientific view of eugenics, and, in fact, has preached its doctrines to the public, and he has in this measure atoned for the shortcomings of the clergy in the matter of racial improvement. Some day it will be understood that eugenics is not opposed to religion, and in course of time as humanity advances it will become a part of the religion of the future. Some sociologists have been unduly alarmed about sterilization, fearing that it would increase sexual promiscuity and thereby spread venereal diseases and remove the fear of impregnation. This danger is more apparent than real. The individuals for whom sterilization laws are enacted are not in the least restrained from their sexual intercourse because of a fear of venereal disease or illegitimate offspring. This question does not worry them the slightest.

Some social workers have objected to sterilization on the ground that the individuals for whom the sterilization laws are written can be segregated, and that emasculation would therefore be unnecessary. Doctor Goddard has answered this argument in a very efficient manner as follows: " If the individuals that are selected for the operation

are never to go out into the world, the operation will be of no very great benefit to society. It will remove a little of the necessary precaution in the institutions. That is of doubtful advantage. But it is true that many institutions for the feeble-minded have inmates that could go to their homes and be well cared for, their lack of ability to earn a living would be made up by others in the family, and the state would be relieved of the burden. If they were safe from the danger of procreation, this would be a proper procedure. It is also true that our institutions for the insane are so crowded that many cases that are known to be chronic and incurable, and are clearly hereditary, are often allowed to go home during their periods of quietness, and while away from the institution they become parents of children who inherit their weakness. If the operation were applied to these people, it would save a large percentage of defective inheritance. In the institutions for the feeble-minded, if these people above alluded to could be sent home, others could take their places, could be trained to work, sterilized and again sent to their homes to be fairly comfortable in those homes. In this way, in the course of time, considerable help could be offered to the solution of this problem, and the burden of caring for so many people for their entire lives in colonies would be, to a certain extent, reduced.

" We thus see that in the present status of the problem neither one of these plans will solve it at once, but since both are good and both can contribute somewhat to the solution, the only logical conclusion is that we must use both methods to the fullest extent possible. As we have attempted briefly to show, and as any one can discover for himself if he will give a little time to investigating the conditions, the situation is fast becoming intolerable, and we must seize upon every method that is suggested and offers any probability of helping in the solution of this problem. In other words, it is not a question of segregation or sterilization, but segregation and sterilization."

There are some physicians and biologists who would attempt to appear both profoundly learned and ultra-scientific, spending considerable time and effort refuting the self-evident and clinical facts of evil heredity which are to be found at every turn. It is sometimes wondered whether these objectors would be willing to submit to a practical application of their own theories to test the sincerity of their statements; would they themselves marry into defective families or

deliberately permit one of their offspring to marry a feeble-minded or syphilitic individual to show the truth or falsity of their contentions? Some objection may be offered to this plan of testing their beliefs on the grounds that it is extreme and unreasonable, but such is not the case. Fournier, the world's greatest syphilographer, deliberately vaccinated himself with syphilis that he might study this fearful disease more accurately than he could otherwise. And no one will dispute that he rendered the world an invaluable service. Carrol and Reed sacrificed their lives in demonstrating to the world that the mosquito (*Stegomyia calopus*) carries the yellow fever germ, and by their supreme sacrifices the world has been freed from the scourge of yellow fever. And as we consider these acts of service to humanity one can in all sincerity and candor ask the objectors to sterilization to demonstrate the accuracy of their teachings if they really believe them.

So much is known at least by the physicians that little need be said upon the methods of emasculation. There are three possible methods of sterilization: (1) Vasectomy or oöphorectomy, (2) castration, (3) by the use of the Röntgen Rays. The operation of vasectomy is a simple one. The skin of the scrotum, and the cord may be anæsthetized by novocain or other narcotic drug. A small incision is made in the scrotum at the site of the epididymis; the vas deferens is isolated, divided and about one-eighth of one inch is cut off. The distal end is ligated; the end nearest the testicle is left patulous, so that the testicular secretion flowing from it may be absorbed by the body economy, thereby preventing any disorder of the body metabolism. The contents of the scrotal sac are then returned and the small skin incision is closed with a single stitch.

In the female the operation is more difficult, as it requires an abdominal or vaginal incision. The fallopian tubes are divided, and the ends nearest the uterus are ligated. The ovarian end of the tube is left open and this permits the absorption of the ovarian secretion which undoubtedly plays a most important part in the body nutrition.

With either of these operations performed the emasculated individual can take his place in society, exercise his sexual power, but he is absolutely incapable of ever reproducing his kind. If this operation of sterilization is performed before puberty, there is likely to be no interference with the normal bodily development, as has been shown by the experience of Doctor Sharp, who says: " I selected a four-weeks-old

male calf, did a double vasectomy and observed development. There was no impairment of the development of the genitalia. He assumed the normal characteristics, such as the thick neck, curly face and deep basso voice and from all outward appearances was a normal specimen of his sex. Likewise, I took a female of the same species and after I severed the oviduct, I observed that she developed sexually to the point of pubescence as any other of her variety do. She menstruated regularly and had all the outward appearances of a normal female which had not borne offspring.

"I have also severed the oviduct in an epileptic female child of eleven years of age. At fourteen she menstruated and has continued to menstruate every twenty-eight days and has full chest development, is feminine in her ways and has no outward appearance of being unsexed. It has been my misfortune that I have not had the opportunity to operate upon a male child prior to the age of puberty, but there is no doubt in my mind but that he would go through to complete sexual development."

In this brief review of the data concerning heredity and sterilization the chief points of interest may be summarized in the following conclusions:

First. Insanity, epilepsy and feeble-mindedness are transmissible diseases and defects in about 66⅔ per cent. of all cases.

Second. Insanity, epilepsy, feeble-mindedness and other forms of psychopathy render the individual so afflicted very susceptible to criminal tendencies.

Third. Approximately two-thirds of all criminals are in some way mentally defective and are the offspring of mentally defective parents.

Fourth. The tendency to crime is indirectly inherited, because mental defect is directly and indirectly inherited.

Fifth. The practice of sterilization upon the incurably insane, epileptic, feeble-minded and confirmed mentally defective criminals would reduce crime to a very large degree by stopping the propagation of these classes.

Sixth. Sterilization is not a predatory measure; on the other hand, it is one of the best social treatments which society has at her command for the betterment of the human race. The sterilization laws should be framed so as to come within the scope of constitutional

rights and the practice should be restricted and guarded in every particular, and always performed after careful investigation by a competent surgeon.

No matter what benefits may be derived from the sterilization of the mental defective, the public in general and the legal profession in particular are not quite ready to pass and enforce asexualization laws. The traditions of the past relative to heredity and personal rights cannot be instantly swept aside. The public must be educated, the laws of heredity and the principles of eugenics must become widely disseminated and understood, and it falls to the physician to be the public teacher since no one else is so capable or competent to give the instruction. The practice of medicine is inseparably interwoven with biology, sociology, morality and eugenics. The surgeons of penal institutions have a splendid opportunity to assist in the development of the science of criminalistics. And when the truth of criminology and heredity are once understood, the opponents of sterilization will no longer look upon it as a predatory measure.

Some day society will learn that it is criminal to permit the feeble-minded, the incurable insane, the epileptic, the syphilitic and other venereally diseased persons to propagate disease, torture, misery and untimely death.

Some day man will seek to regenerate man, since the physical and mental salvation of the human race lies within his own hands. When he learns that the laws of nature are the laws of God; when " the sins of the fathers shall be visited even unto the third and fourth generation," he will then cease to apply the needless and fruitless methods of reformation to cure the social degeneracy which could have largely been prevented.

INFLUENCE OF INTERFERENCE WITH CIRCULATION ON PAIN NERVE TRANSMISSION

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THAT oxidation of tissues enhances cell activity is obvious. The better and more active the circulation, both arterial and venous, the more health will each individual cell in that special locality have. The more active the individual cell is, the more influential will each cell be on contiguity transmission.

This view of the situation will apply to all cells of any form of tissue, hard or soft, as for instance, the forearm. Let a person use the forearm moderately for fifteen minutes, and immediately the blood vessels become dilated. For a given period, more blood passes any point than previously in the same time. First the muscles become tonic, then the skin becomes reddened, and we realize that the sense of touch and the feeling of well being is augmented. Again, when we first awaken in the morning, following a night of restful slumber, the soft tissues are all relaxed. We feel that we have not the strength and activity that was ours when we retired. Recline five minutes and what a change! The cerebral cells become active, a new circulation seems to start, then suddenly a new feeling of full control comes over the body. If at this point we arise and the cool air of the room comes in contact with our skin and we feel braced, in the course of time during the completion of our toilet, we gain strength and the realization of benefit gained from the night of slumber comes to us. By the time we are ready for the morning meal, this feeling of well being is well established in the healthful individual. For just this reason the cool morning bath, also which follows the regular calesthenics of an ordinary individual, readily enhances the deep and superficial circulation, and so at the completion of the body rub, we feel " fit to fight."

Why is this all true? It is because of the increase in the number of heart beats which comes upon the awakening and the activity

that follows. This in turn has bathed each individual cell in more fluid and the greater oxidation has brought about a more marked cell activity.

Again referring for a moment to the more intellectual class of individuals, compare the amount of nerve force put forward by deep thinking, studious people or by a man who builds up a business. Because they freely indulge in the thought and study of essentials, they exert a great deal of nerve energy daily, and thereby enhance the cerebral circulation. An intellectual person who has to undergo an operation for inguinal hernia, because of some other physical infirmity, cannot be given a general anæsthetic. He is, however, freely subservient to the psychological influence which is necessarily a part of the operative preparation. He is also the more subservient because of the training he has had in his business, profession, or his work as an accountant. On the other hand, a person who is illiterate, if placed in a position whereby he has to undergo an operation under local analgesia, because of this lower intellect, cannot appreciate or interpret the psychological suggestions given. As a result, we find that he often fails us at the last moment during the operation and requires some general anæsthetic at the risk of its deleterious influence.

This all reverts back to the circulation governing the higher nerve centres. The intellectual man has the augmented circulation governing his centres and is thereby able to acquire the necessary suggestions; on the other hand, the illiterate man cannot be expected to do this and for this reason he offers a stumbling block to success. Herein is a very strong argument for the mental uplift of all people, that the mental faculties may not be neglected while securing an extreme physique. The reverse is also true that none should permit ultra mental attainments to be deleterious to the physique. An even balance is necessary for the best results as the following incident shows. I recently met a college president who told me that the entire back field of the football team was composed of men who stood ninety per cent. or better in their studies, so that they had developed both of our assets to the point of ninety per cent. production. That is just what all should endeavor to do, no matter what the line of mental or physical activity.

We should stand individually and collectively for equalization

along the lines of growth and progress. It can be plainly stated that the back field of the college football team refered to, would individually or collectively make good subjects for an operation under local analgesia. Further it might be stated that this same college president told me of a man who made a very good showing with his physique who was a sixty per cent. man in his studies. He was a candidate for the back field and was given a good opportunity to play. It was noticed, however, that whenever he did play he was a drawback to the active functions required for the success of the team. For this reason he held a substitute position instead of that of a regular one. It would be safe to state that he would fall down during an operation under attempted local analgesia, and would require a general anæsthetic at some stage of the operation.

The purpose of the following experiments was to determine what influence, if any, the interference with normal circulation had upon the pain nerve transmission as shown by the nerve cell changes in the cord and cerebral cortex. Nothing but the influence of interfered circulation will be covered. In carrying out these experiments, guinea pigs were used. As in the previous experiments along this line, healthful pigs of average weight were used. These experiments were in no wise more difficult to carry out than the earlier ones.

Five sets of experiments were done as follows:

1. Control experiment under normal circulatory influences.

2. Tourniquet about one extremity thus partially arresting the normal circulation.

3. Ligation of both common carotids, by decreasing the normal amount of blood going to the cerebral cortex along usual channels.

4. Local and systemic contraction of the circulatory channels with its effects.

5. Local and systemic dilatation of the circulatory channels with its effects.

For each one of these experiments pain was produced by making multiple incisions with a sharp scalpel. Each experiment was continued for thirty minutes, that the influence of time might be shown while the specific circulatory condition existed and the pain nerve transmission remain the same. It was also deemed advisable to augment this pain nerve transmission for a five-minute period, at the conclusion of the thirty-minute observation, in order to illustrate

what influence a greater degree of pain nerve transmission would have while the circulatory condition remained the same. Each experiment was carefully recorded and the findings statistically filed for reference. The following are the conclusions drawn:

EXPERIMENT I.

Guinea Pig No. 1.—Normal, healthful guinea pig of average weight. No supporting measures were given. Three incisions were made in the skin of one foreleg, each one inch in length. The pig was allowed to remain thirty minutes after the incisions were made. A lethal dose of morphine was then administered. Following the death of the pig the brain and cord were removed. The accompanying photo-micrograph (Fig. 1) will show the results. Pain nerve transmission of the first degree. Cerebral cortex cells showing confluent nephelation accompanied by vacuolation, and pronounced changes. This is merely a control experiment by which to make a comparison with the following experiments:

EXPERIMENT II.

Guinea Pig No. 2.—Tourniquet in the form of a quarter inch rubber elastic band was placed about one foreleg so as to partially arrest the normal circulation and allowed to continue for fifteen minutes, when three incisions, each one inch in length, were made through the skin distal to the tourniquet. Thirty minutes after the incisions were made a lethal dose of morphine was given. It will be seen from the illustration (Fig. 2) that the cortex cells are nephelated only here and there, and that no confluent nephelation or vacuolation is present while the pain nerve transmission is of the third degree.

This picture is in marked contrast to the illustration of the previous experiment, and shows that interference with normal circulation in itself is a partial analgesic in effect. The results of this experiment are most emphatic, as no supporting or nerve block methods were used.

It would seem that the analgesia produced was due to the absence of oxygen or the presence of carbon dioxide or both. It was not due in any measure to the osmosis or diffusion as no œdema was present distal to the tourniquet. It would be unusual in a healthful system for œdema to form in so short a time as occupied by this experiment.

We do know, however, that the lack of proper oxidation will produce the cyanosis which results in a local or general analgesia depending upon the extent of that cyanosis. We can therefore rightly assume that the analgesia herein produced was secondary to improper oxidation of the tissues. On the contrary we realize that inhalation of carbon dioxide as shown by rebreathing is a stimulant rather than otherwise. To further the stand of improper oxidation as the producer of the analgesia we have to but compare a person with a double pneumonia and an embarrassed heart, where we have a marked cyanosis (at times). How easy it would be to do a venesection at the forearm in these cases without any other form of analgesia media. Incision of the skin at this time produces practically no pain.
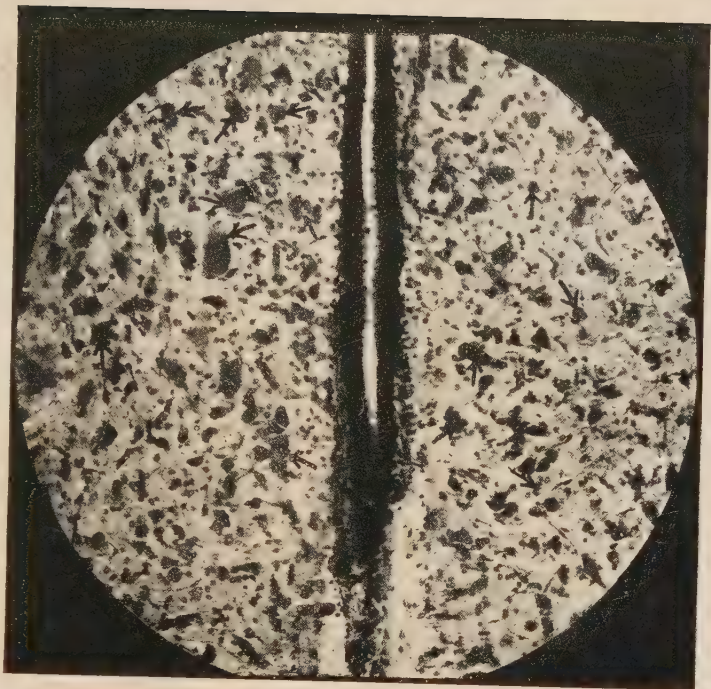
EXPERIMENT III.

Guinea Pig No. 3.—Both common carotids were ligated under very painstaking technic of very profound local analgesia. The infiltration and nerve block were made, and dissection and ligation very quickly done. As the pig was very quiet during this procedure, it can be safely assumed that no pain was produced. Thus we can safely rule this out as a cause for pain nerve transmission. Our previous experiments would also support us in this assumption. Following the ligation of the carotids, the pig lived about thirty minutes, dying without any morphine to assist. Immediately following the ligation the respirations became deep and slow. This was followed in about five minutes by a quickening of the respiration and a gradual decrease in the depth. At the very end the respirations were very quick and shallow. After the cessation of respirations the heart continued to beat for about five minutes.

Fifteen minutes after the carotids were ligated three incisions, each one inch long, were made in the skin of one foreleg. Cerebral cortex cells showed no marked alteration, although now and then a cell was seen in which slight nephelation had taken place, which was not full and complete in any of the cells examined. The pain nerve transmission was of the fourth degree or practically nil.

This experiment shows the control of pain nerve transmission of the cerebral cortex cells from a central point of view, or in other words the analgesia was produced in the cells themselves through the interference with the normal circulation at the point of reception of

Fig. 1.

Control experiment, cerebral cortex cells. No supporting or other measures were used. Pain nerve transmission of the first degree. Note the marked confluent nephelation and vacuolation.

Fig. 2.
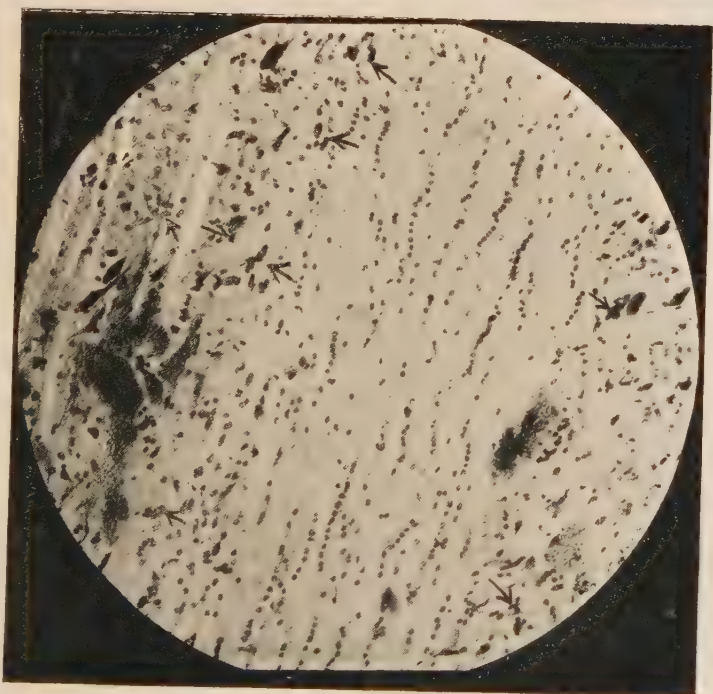
Cortex cells showing discrete nephelation, no confluation or vacuolation. Pain nerve transmission of the third degree.

Fig. 3.

Cortex cells showing only now and then a nephelated cell nearly normal in all areas. Pain nerve transmission of the fourth degree.

Fig. 4.

Cerebral cortex cells showing very discrete nephelation and then only partial. Pain nerve transmission of the third degree.

Fig. 5.

Cerebral cortex cells showing confluent nephelation and vacuolation. Pain
nerve transmission of the first degree.

Fig. 7.

Cerebral cortex cells showing confluent nephelation and vacuolation. Pain nerve transmission of the first degree.

Fig. 6.

Cerebral cortex cells show marked confluent nephelation and vacuolation. Pain nerve transmission of the first degree.

the impulse rather than at the peripheral point of influence. One step further in corroboration of the nil pain nerve transmission was inaugurated. Sections of the cord were made to show the effect of the pain nerve transmission on this part of the nervous system. In other words the central avenue of the pain nerve transmission impulse could be shown in the cord, and the influence brought to bear by the analgesia produced by lack of proper oxidation above. It was certain that no direct lack of oxidation would have any bearing upon the cord as such. What influence was produced in the way of analgesia in the cord as shown by the altered cells must have come through retardation or interruption of the influences from the cerebral cortex cells on their way through the cord. Just how much influence this would have in cell alteration is shown by the illustrations.

The illustration (Fig. 3) clearly shows that there is no cell alteration in the cord, and no injury had been done the cord. The only thing present had been a retardation of the nerve influences going down the cord from the cerebral cortex. However, we would at once assume that there must be some pain nerve transmission of an efferent nature up the cord toward the cerebral cortex cells. These efferent influences would not be retarded unless some other influence was brought to bear, as this part of the central nervous system was not sluggish as a result of a desire to accomplish the direct purpose of its own accord. Therefore, if we find as we do, any cell alteration, we must look for other causes. Naturally, under the circumstances of this experiment, the influence we first consider is that of analgesia secondary to the remote interference with oxidation in the cerebral circulation. Here we find that such a local influence did have its effect upon the general oxidation. Therefore what influence we find by alteration of the spinal cord cells we must decide is the result of analgesia secondary to improper oxidation. We may also conclude that two circumstances exist at the same time, in the cords and not elsewhere, that the afferent influences are retarded by the impoverished circulation of the cerebral cortex and that the efferent influences are not affected by this same influence to any marked degree, although the improper oxidation here plays an important rôle. Again we find a peripheral influence which exists and was present in the limb upon which the multiple cuts were made. These cuts must have caused a hasty efferent pain nerve transmission and ended in a slow efferent

pain nerve transmission recoil. The degree of influence this had on the cerebral cortex cells is clearly shown by the illustration.

Practically quite complete analgesia was present in the experimented extremity, and sluggish action in the cerebral cortex cells is clearly shown as a result. Thus is shown how easily distal or peripheral analgesia is produced by a remote influence upon the central or cerebral cortex cells direct.

As in the numerous operations we have done covering the varied lines of this work, we always lead up to some new field of thought. Here we are immediately faced by the problem of analgesia as a result of one or both of two influences. The sluggish cerebral cortex cells as incapable of accepting afferent influences readily, and further transmitting them, and also this same sluggishness relays its influence to the cord and peripheral nerves. The inability of the cerebral cortex cells to interpret the impulses as afferent and to transmit them in the form of efferent ones. This afferent and efferent difference in itself combined and separated from the analgesia of oxidation, would readily furnish ample material for a lengthy article. Possibly, later we can take the time to work on this phase.

EXPERIMENT IV.

Part 1.

In this experiment vaso-motor contracting stimulants were used, both locally and intravenously. Adrenalin which was the substance used, was selected because of its quick and lasting influence. Two drams of a five per cent. solution were infiltrated into the forefoot of a normal guinea pig. Following the careful injection of this material the same procedure was carried out as in the previous experiments. Four linear incisions were made in the foot fifteen minutes after completion of the injection. Thirty minutes later, the pig was given a lethal dose of morphine.

The accompanying illustration (Fig. 4) shows the effects of pain nerve transmission on the cerebral cortex cells with pain nerve transmission of the third degree, and an occasional partial nephelation.

Part 2.

To accomplish general vaso-motor contraction fifteen minims of adrenalin with fifteen minims of sterile water were given intravenously. Fifteen minutes later, the regular four linear incisions were

made in the foot, and thirty minutes afterwards a lethal dose of morphine was given.

The cerebral cortex cells show pain nerve transmission of the first degree with confluent nephelation and vacuolation (Fig. 5).

There must be some definite reason why the local vaso-motor constriction should so fortify the pig against pain nerve transmission, while the systemic contraction should render no such fortification. In so far as we are able to determine, the fortification from the local vaso-motor constriction was in itself not present. The infiltration of any tissue from sterile water alone will produce some degree of nerve block from mechanical pressure and evidently that is what was produced in this instance. Very often when only a small incision in the skin is necessary for the freeing of pus or other minor dissection, we use but sterile water and get most satisfactory results. For this reason, we believe that the adrenalin played a nil part in this experiment. Thus beyond doubt, a local or general vaso-motor constriction has no influence on pain nerve transmission.

EXPERIMENT V.
Part 1.

To produce a local dilatation of the blood-vessels, the following method was used: A normal, healthful guinea pig was *chosen* and one forefoot was submerged in comfortably hot water for one minute. Immediately then it was withdrawn, and submerged in ice-cold water for fifteen seconds. This process was repeated ten times and then the forefoot was allowed to soak in hot water for five minutes. The first half of this procedure was intended to ultra stimulate both the vaso-motor constrictors and dilators. The second half was intended to fully actuate the vaso dilators and put the vessels at hyper dilatation with over-distended blood-vessels. Immediately after the conclusion of the second half, four parallel incisions were made in the skin and the pig was allowed freedom for thirty minutes when he was given a lethal dose of morphine.

The accompanying illustration (Fig. 6) shows the first degree of pain nerve transmission, and also that the cerebral cortex cells are confluently nephelated and that vacuolation is marked. This proves clearly that pain nerve transmission was not interfered with, and the dilatation of the vessels in the forefoot apparently had no influence one way or the other.

Part 2.

To produce a condition, systemic dilatation, a healthful normal-weight guinea pig was given 1/400 grain of nitroglycerin. He was permitted to go about leisurely for a half hour, then the usual procedure of making four parallel incisions in the forefoot was carried out. Thirteen minutes later the pig was given a lethal dose of morphine.

The illustration of a section of the cerebral cortex (Fig. 7) will show confluent nephelation and vacuolation, and pain nerve transmission of the first degree. Thus it will be seen that systemic dilatation of the vessels apparently had no influence one way or the other on the degree of pain nerve transmission. From this experiment, it will be clearly seen that full dilatation of the vessels locally or systemically has no influence upon pain nerve transmission. Possibly from a practical point of view, we might expect such a condition would augment pain nerve transmission, but as we got a first degree result, evidently no such influence was maintained or even reached.

At least this last experiment is somewhat interesting in that it would permit the thought that any influence computing a high feeding ability on the part of the blood vessels, has no influence upon pain nerve transmission. This stands out in strong contrast to the opposite partial influence which vaso-motor constriction has upon pain nerve transmission.

RÉSUMÉ.

Experiment I shows pain nerve transmission under no blocking or other influence which gives pain nerve transmission of the first degree; such as would exist under circumstances in which outside influences other than the pain producing one existed.

Experiment II.—This experiment shows that interference with normal circulation has the direct result of partially blocking normal pain nerve transmission, and causes pain nerve transmission of the third degree.

Experiment III.—Here a marked interference with normal cerebral circulation was caused as shown by the ultimate death of the pig without the use of morphine. This interference had a marked influence on the pain nerve transmission, which was of the fourth degree.

Experiment IV.—Vaso-motor contraction, when brought about locally shows a marked influence upon pain nerve transmission, which is of the third degree. This experiment, if compared, would for all practical purposes show the same result as those of experiment No. 2, although the pain nerve transmission is one degree less. It does, however, show that interference with normal circulation through constriction or in other words, by reducing the normal flow of blood does, in some way, partially analgese.

Experiment V.—Here it is clearly shown that vaso-motor dilatation gives no assistance to the production of local analgesia, or systemic favorable blocking influence to pain nerve transmission. The results are the same as if no extraneous methods had been used. Possibly the full dilatation of the vessels would augment pain nerve transmission, under some circumstances. However a comparison of this experiment with No. 1 shows similar results.

CONCLUSIONS.

1. Interfered circulation tends to produce either a local or general analgesia and possibly amnesia.

2. This circulatory interference assists in partially blocking pain nerve transmission.

3. The influence of improper oxidation upon analgesia is quite apparent, although no attempt was made in these experiments to use ultra physiological chemistry.

4. If we have not at hand the theraupetical analgesic producing materials, interference with normal circulation will assist in accomplishing the end, at least, in part.

5. Vaso-motor dilatation has no potential influence upon the production of analgesia, nor assists in blocking pain nerve transmission.

INTRA-ABDOMINAL AND INTRA-PELVIC ADHESIONS

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INASMUCH as pre- and post-operative intra-abdominal and intra-pelvic adhesions are of considerable importance from the standpoint of the surgeon, it seems a strange commentary that the literature on the subject is not more voluminous. In practically every type of pathology involving the intra-abdominal and intra-pelvic viscera, especially when attended by infection and inflammatory tissue-reaction, concomitant or subsequent adhesions may be expected to occur. The same statement will apply to the infliction of mechanical trauma and injuries resulting from chemical agencies.

The majority of those who have contributed anything of value from an experimental standpoint to our storehouse of knowledge on this subject seem to be of the opinion that adhesions "represent a conservative reaction on the part of the animal economy and all are essentially benign in their intent." And it is true this feature is clinically illustrated by the early formation of protective adhesions in the presence of abscesses involving the intra-abdominal and intra-pelvic viscera, notably those occurring in the region of the appendix cæci vermiformis, the ovaries, oviducts, etc. The failure of nature to thus protect the general cavity under such circumstances against further invasion of the infective agent through contiguity of structure or otherwise usually means extension of infection with ultimate dissolution of the individual unless the aid of surgery be early invoked.

In the broadest sense, says Corbett, the term "adhesion" includes everything from peritoneal agglutination to true adhesions composed of connective tissue with definitely organized blood-vessels. " For practical purposes an adhesion is a definite organization of scar tissue between two or more structures." According to Hertzler, the first step in the formation of peritoneal adhesions is the exudation of serum and a change in the endothelial-cells. The exuded serum coagulates and forms fibrin, particularly at the edge of the process. While the

fibrin formation is taking place, polynuclear leucocytes escape into the coagulated mass, and within a few hours round-cells collect in the fibrin. The fibres of the basement membrane then begin to loosen and different fibres become entangled with those of the opposing peritoneal layer. The fibrin formation at the beginning appears to remain and serve as a scaffolding for the subsequent process (Hertzler).

ETIOLOGY

Many factors may be concerned in the causation of intra-abdominal and intra-pelvic adhesions, but infection seems to be the most important; and the addition of chemical or mechanical trauma intensifies the effect of infection. It has been repeatedly shown that aseptic surgical procedures executed upon uninfected intra-abdominal and intra-pelvic viscera are seldom followed by adhesions, unless the surgeon be so unwise as to institute drainage following his operation. There can be no doubt that the formation of adhesions is encouraged or promoted by the employment of either capillary or tubal drainage—a practice which should long ago have been relegated to the oblivion of past performances excepting when there exist most positive and definite indications therefor, such as infected areas or pus-pockets otherwise inaccessible which may later endanger the life of the individual.

In a most excellent paper reviewing the clinical and experimental aspects of peritoneal adhesions, Corbett reiterates the pertinent fact that the rôle of aseptic trauma in the production of adhesions is insignificant, but in the presence of infection the etiologic importance of this element is undoubted. "All of our experiments emphasize the importance of the traumatic factor when taken in conjunction with infection, but minimize it *per se*. . . . Infection alone in our series did not produce as severe adhesions as occurred in infection plus trauma " (Corbett).

Walker agrees that pre- and post-operative adhesions within the abdominal and pelvic cavities are of extreme interest, and the subject should be accorded more extensive study by every physician and surgeon than has hitherto obtained. He proposes the following zones for study and diagnosis: (*a*) the cæcal, (*b*) the pyloric, (*c*) the omental, and (*d*) the pelvic zone. Especial attention is directed to

the omental zone as the omentum plays a more important rôle in adhesions than generally conceded. " The omentum is a greater offender as well as a great defender." The author believes that in many instances where gastro-enterostomy has been performed, the appendix removed, or the cholecyst drained, without favorable result, the omentum was the cause of the disturbance. After describing some of the adhesions which may occur in the various zones he declares that pelvic adhesions cause no disturbance of nutrition, but do cause more nervous phenomena than in any other zone, and " the reason for this nervousness is almost wholly dependent upon the sexuality of the individual."

From the viewpoint of the causation of intestinal adhesions, the experience of Chislett and others would seem to indicate the order of frequency to be: (a) former attacks of inflammation (infection) of some intra-abdominal organ, (b) injudicious manipulation and lack of gentleness in necessary handling of the intestines and other intra-peritoneal organs during previous operations, (c) traumatisms through contusions or wounds of the abdomen, including too forceful reduction of herniæ, the improper application of truss pressure, and the injection treatment of herniæ, (d) the use of drainage after operations, either capillary or tubular, (e) imperfect wound healing with resulting ventral hernia, and (f) idiosyncrasy—some patients seeming predisposed to the formation of adhesions even upon the most gentle manipulation.

Based upon his clinical and experimental studies, together with a review of existing literature, Corbett presents the following conclusions:

(1) That adhesions are benign in their intent, but may become perverted.

(2) That adhesions, if left alone, tend to disappear spontaneously.

(3) That of the various etiological factors infection seems to be the most important.

(4) That trauma intensifies the effect of infection.

(5) That ether seems to be the most satisfactory chemical means of combating infection; it is not devoid of danger, and is not always effective.

(6) That postural treatment is important in minimizing the symptoms of adhesions.

(7) That omental grafts may be used in covering raw surfaces, but should never be employed in the presence of infection.

(8) That the use of citrate and oil does not seem to be justified.

(9) That foreign bodies, such as Cargile's membrane, in themselves produce adhesions—and oftentimes very undesirable adhesions.

(10) That hæmatomata are a cause of adhesions.

(11) That the cautery is a useful agent in preventing adhesions.

(12) That section of nerves, as may occur in the right rectus incision, predisposes to adhesions.

PREVENTION

In the attempted prevention of post-operative intra-abdominal and intra-pelvic adhesions many extraneous substances have been recommended and employed both exprimentally and clinically, but their general applicability and effectiveness seem exceedingly questionable. In my opinion the introduction of foreign material into the peritoneal cavity of the human being for any purpose whatsoever is fraught with danger, and the disadvantages of the various agents advocated to prevent adhesions have seemed to outweigh the possible advantages.

The experimental investigations of Sweet, Chaney and Willson, Craig and Ellis, Corbett, and many others, have demonstrated the futility of attempting to prevent adhesions by utilization of the various oils, sodium citrate, paraffine, lanolin, gum arabic, Cargile's membrane, Prime's colloidin, etc.; moreover, the employment of such agents oftentimes seemed to augment rather than limit the production of adhesions. " The attempt to prevent the formation of adhesions by inhibiting fibrin formation with the use of citrate, phosphorus, or peptone, while it may for a time postpone scar-tissue formation, does not seem advisable for the following reasons: The use of citrate, particularly, makes the control of hemorrhage difficult; and, according to Sweet, Chaney and Willson, it tends to disseminate infection and interferes with repair " (Corbett).

Not many years ago, *i.e.,* in 1914, Lyman and Bergtold published a preliminary note on the use of amniotic membrane for preventing post-operative adhesions, but as no further reference to the procedure can be discovered in available literature it is probable that, like other not dissimilar surgical innovations prematurely made public, the method was promptly abandoned because of its inadvisability

or ineffectiveness. However, a summary of the views expressed by the authors may be interesting. It was claimed that amniotic membrane might be successfully utilized to prevent post-operative adhesions, either those preëxisting and separated during operation, or those following primary operative intervention. It was specified that the membrane must come from a constitutionally healthy individual, be thoroughly washed in running water, and preserved in 0.5 per cent. formaldehyde in 70 per cent. alcohol. The membrane was stitched over denuded areas with catgut. The advantages claimed were: (a) that the membrane could be readily secured in sheets of reasonable size, (b) that it was sterile to begin with, easily preserved and kept sterile, (c) that it was thin and probably readily absorbed. Seven cases were mentioned in which the results of this method of procedure were said to have been entirely satisfactory, preëxisting distressing symptoms ascribable to peritoneal adhesions being totally obviated. One case is reported *in extenso,* an abstract of which is interpolated for what it may be worth:

A female of twenty-five, operated upon for appendicitis seven years before coming under observation of the authors; two years ago posterior gastro-enterostomy for gastric ulcer; numerous adhesions separated. Shortly thereafter the patient exhibited symptoms explicable only by abundant recurring peritoneal adhesions in upper abdominal cavity. Subsequent celiotomy revealed extensive reformation of adhesions involving liver, cholecyst, duodenum, stomach and transverse colon. These were freed, the denuded surfaces "smeared with sterile oil," and the abdomen closed. Within a week return of previous symptoms, and five weeks later it was decided to reopen the abdomen and employ chorionic membrane to prevent new adhesion formation. This was accordingly done, three sheets of chorionic membrane being used, each about five inches square; the first was interposed between liver and cholecyst, and duodenum and stomach, the second between transverse colon and small intestine beneath, the third under the abdominal incision, the three sheets being held in position by catgut stitches. Five months after the last operation the patient had remained free from distressing symptoms which had previously existed many months. The authors claimed their results seemed to warrant the following conclusion: (a) that the method was harmless, (b) that it seemed to prevent the formation of

peritoneal adhesions, (c) that it was easy of application, and (d) that it was worthy of further trial.

Of the more recent experimental work in connection with the limitation or prevention of post-operative adhesions, only that of Sweet, Chaney and Willson will be further reviewed. These authors conducted a series of animal experiments to prove or disprove the value of various agents suggested to prevent or limit post-operative intestinal adhesions. The type of operation was identical in all the experiments, especial attention being devoted to rigid asepsis and "gentle" manipulative technic. The first experiment (used as control) was end-to-end intestinal anastomosis on two dogs; animals killed in six and eight weeks, respectively; at autopsy the abdomen was free of adhesions, intestine normal, no signs of peritonitis. The second consisted in noting the effect of covering operated area with attached omentum. This produced similar results, excepting adhesions where omentum was purposely fixed. Two dogs were treated by using free omental or mesenteric grafts; these at autopsy showed no adhesions.

Studies were then conducted to demonstrate the effect of liquid paraffine, sterile olive oil, and "glymol" in limiting or preventing adhesions, the abdominal cavity being injected ten minutes before operation; sponging during operation was with gauze saturated with sterile oil; in every instance there was either peritonitis or adhesions with marked exudation. In three dogs 100 ccm. of oil were injected into abdominal cavity and no operative work done; autopsy showed large amount of exudate and adhesions varying in intensity—greater in dogs allowed to live longer. Of eleven experiments in which some type of oil was used, adhesions were found in nine; in one where no adhesions were noted the animal died of peritonitis; more or less extensive exudation was present in every case. In seven the phagocytic index was tested and found markedly reduced in all excepting one; and in that one it was not normal. "Oil in any form causes an intense exudation of leucocytes, and these are inhibited from their normal physiological function by the presence of the oil."

Seven experiments were made by pouring 50 ccm. of a 3 per cent. sodium citrate solution into the abdominal cavity after performing entero-enterostomy. This interfered with healing and did not prevent visceral adhesions.

The authors conclude that the only methods by which adhesions may be limited or prevented are: (*a*) to limit the wounds of the peritoneum, which can be done by careful technic, and (*b*) by covering necessary wounds with freed or attached omentum or mesentery.

Of infinitely greater importance, of course, than experimental investigations are the clinical observations of experienced surgeons, although I do not wish to be understood as underestimating the value of animal experimentation, nor the application of information thus acquired to the alleviation of human afflictions. It is interesting to note that clinical experience has demonstrated many curious and perplexing angles concerning the subject of intra-abdominal and intrapelvic adhesions; *e.g.,* no one seems capable of satisfactorily explaining why in one instance extensive post-operative adhesions occur and persist for months or years, whereas following another operative procedure identical in every particular no adhesions are observed. Moreover, there has yet been suggested no adequate explanation why more or less extensive adhesions observed at operation, but which are allowed to remain undisturbed for good and sufficient reasons, produce no subjective symptoms and eventually entirely disappear as demonstrated by subsequent celiotomy.

The assertions of others to the contrary notwithstanding, intra-abdominal and intra-pelvic adhesions are not always benignant in intent or effect, nor do they invariably disappear without treatment; and even after mechanical separation or surgical division, reformation is not infrequently noted. In proof of this statement, Murphy cites a case in which fourteen celiotomies were performed for adhesions following appendicectomy, with final good result; Griffenhagen mentions a patient who underwent ten operations before even moderate relief was obtained; Stavely refers to a case in which seven operations were performed (one intestinal resection) with only partial relief. Were the assumption correct the adhesions " are benign in intent " and invariably disappeared without treatment, the work of the surgeon would be greatly simplified, and the importance of careful technic and gentle manipulation correspondingly minimized.

Reichelderfer aptly remarks that the whole subject of intra-abdominal and intra-pelvic adhesions is fraught with puzzling contradictions. We cannot explain why adhesions sometimes follow the most trivial surgical procedures, whereas in other instances no ad-

hesions occur even after prolonged exposure or forcible manipulation of the abdominal or pelvic contents. Again, the relationship between adhesions and resulting symptoms is contradictory. Oftentimes extensive adhesions are not accompanied by discomfort, whereas severe symptoms are produced by slight adhesions, " though no doubt the recent findings of the marked differences in sensibility of various parts of the peritoneum will explain this apparent variability of cause and effect." The author mentions a girl who underwent six celiotomies within three years, five of which were performed for the relief of symptoms due to adhesions.*

It is suggested by Reichelderfer that much may be done to prevent adhesions by consuming as little time as possible in operating, as mere exposure of the open abdomen to the air is known to be harmful; by inflicting as little trauma as possible; by avoiding unnecessary manipulation, violent sponging and wound retraction; by careful hæmostasis, as blood-clots in process of absorption will cause dense adhesions, by using only moist sponges and pads, as dry gauze is particularly irritating; by the use of drainage only when absolutely necessary and then employing rubber drainage tubes or gauze protected by rubber tissue, and never unprotected gauze packing; by covering raw surfaces and pedicle stumps as completely as possible with peritoneum or omentum; by protecting the intestine from irritating fluids or antiseptics, and especially preventing coils of intestine from lying on the unprotected field of operation which has been prepared with iodine.

The recommendations of Chislett are interpolated merely for comparison as they differ in some essential respects from the foregoing. He claims that the prevention of adhesions following operations upon abdominal organs depends on the following factors: Gentleness of manipulation in all necessary handling of the tissues; the avoidance of unnecessary exploration by more careful case-taking and more accurate diagnosis; the free exposure of the field by sufficiently large incisions, and especially by posture, to minimize the

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* In referring to this case Corbett states that the patient was "operated upon ten times for adhesions," which is evidently an error. Reichelderfer's original statement shows that " from 1906 to 1909 this girl was in hospitals on ten occasions aggregating about two hundred and fifty days, and underwent six operations." The first operation was for appendicitis in 1906.

necessity of blind and blunt separation of adhesions; the use of moist rather than dry packs, excepting where their retention may be demanded for protection; the avoidance of drainage wherever possible; the use of normal saline solution poured into the peritoneal cavity after completing the operation; the early establishment of a continuance of peristalsis; the assumption of a posture favoring the prevention of contact with sutures or ligated parts; the frequent change in position of the patient; the suture of the peritoneal wound with edges; the covering of denuded areas not amenable to suture with omental grafts; the use of sterile " omental" oil rather than normal saline solution where denudations cannot be properly covered.

SYMPTOMATOLOGY

While the clinical symptoms produced by the presence of intraabdominal and intra-pelvic adhesions are so familiar to every physician and surgeon that further detailed description may appear a work of supererogation, a brief summary may be permitted. The most prominent manifestations are: pain and rigidity with evident fixation of the implicated intra-abdominal or intra-pelvic viscera. Gastroenteric symptoms, as evidenced by disturbances in digestion and nutrition, are not uncommonly observed where the ventricular, pyloric, duodenal or even the hepatocystic structures are involved, and careful clinical and laboratory investigations may sometimes be required to exclude ulcer and carcinoma.

In intra-pelvic adhesions there is always present a characteristic " inelastic, dense, pelvic floor." Any attempt to elevate the cervix or depress the uterus increases clinical discomfort because of the limitation in mobility of these structures. Rarely will the ovaries and oviducts be involved in adhesions without extension of the process to the uterus from structural contiguity. Where the resulting exudate is extensive an indistinctly definable tumor may be noted on palpation, which must be differentiated from ovarian cystoma or small uterine myofibroma.

The most serious sequel or complication of intra-abdominal or intra-pelvic adhesions is partial or complete fæcal stasis. It is usually of the latter type and acute in character, due to inordinate pressure from adherent viscera or to constricting bands of adhesion or intestinal kinks resulting therefrom. MacMillen, in an interesting paper

on peritoneal adhesions and their relation to fæcal stasis, suggests the following as the most important etiologic factors: (*a*) adhesions drawing the lower end of the ileum downward, (*b*) causing displacement of the cæcum toward the median line, (*c*) drawing the transverse colon downward so a portion is parallel with the ascending or descending colon, and (*d*) fixing a loop of the sigmoid flexure in the abdomen above the pelvic brim. " These four types are common and any one of them may cause chronic constipation which will resist every form of treatment excepting removal of the adhesions."

TREATMENT

Little further comment seems necessary concerning the treatment of intra-abdominal and intra-pelvic adhesions, the most important features having been outlined under the section on prevention. Medical management merely represents a delusion of misguided enthusiasts, and the successes reported under the internal administration of drugs and the external application of various so-called " penetrating and absorptive " substances may be easily explained upon a more reasonable and understandable hypothesis, *viz.,* the spontaneous disappearance of the adhesions.

Walker suggests that anyone who has made a careful study of the subject can readily understand and appreciate why medical men have claimed to cure adhesions through medication. The reason is obvious, as adhesions always tend to disappear; and in the majority of instances " if the surgeon, the physician and the patient has enough patience to give nature a chance to assert herself in the proper manner, more than 90 per cent. of patients having adhesions will entirely recover."

While the premise has already been admitted that adhesions sometimes spontaneously disappear, the author just quoted must certainly be greatly mistaken in his figures, as such a fortunate termination in " more than 90 per cent." of instances would be contrary to the experience and observation of practically every surgeon in Christendom who has performed even a limited number of abdominal operations. In this connection, the facetious commentary of a famous gentleman long since deceased seems strangely *á propos:* " It is better not to know so many things, than to know so many things that are not so."

It is a fact well established by surgical records that the most modern and approved operative treatment of adhesions, which, of course, presupposes careful separation or division and suture with or without the interposition or covering of denuded surfaces with peritoneum or omentum, more often than otherwise fails in the production of permanent relief of clinical discomfort, because of the tendency to adhesion reformation following mechanical trauma necessarily inflicted during the procedure, despite the exercise of infinite care and observance of gentle manipulation. However, this feature has already been sufficiently emphasized herein by citations from the work of some of the most prominent surgeons in the world. The fact remains that the treatment of intra-abdominal and intra-pelvic adhesions is essentially surgical and is never medical, although the ultimate results accruing from primary operative measures may not always be entirely satisfactory to either patient or surgeon.

Where the symptoms produced by adhesions are not sufficiently urgent to demand immediate operative intervention, and particularly in the post-operative type, delay is advisable in the hope that nature will be successful in relieving the situation in the course of a few months. In the absence of such a fortunate eventuation, with increase in severity of clinical discomfort, of course it becomes the imperative duty of the surgeon to intervene.

While both pre- and post-operative adhesions are less commonly noted in the upper than the lower abdominal cavity, it has been my observation that the former—especially where the stomach, duodenum, transverse colon and liver were involved—seldom disappear spontaneously; whereas spontaneous disappearance not infrequently occurs in the latter. Whether or not this observation is in accord with the experience of other surgeons I do not know.

The greater tendency to the formation of adhesions in the lower than the upper abdominal cavity attending infection or subsequent to operative procedures is probably due to the difference in bacterial flora in the two situations, as suggested by Corbett, who says: " It has been my observation in some two hundred intestinal anastomoses that any invasion of the lower bowel was almost sure to be followed by adhesions; while the jejunum and duodenum could often be entered without any such consequence."

As this paper has particular reference to adhesions involving

viscera located within the lower abdominal cavity, I wish to report two illustrative cases in which the most extensive adhesions I have ever observed disappeared spontaneously after the original celiotomy by secondary operative intervention. In no other instances where patients have been subjected to secondary celiotomy have I noted complete disappearance of preëxisting adhesions. However, it is presumed surgeons of greater experience have observed many such cases.

CASE I.—Mrs. F. T., aged thirty-two, mother of one child eight years old, first came under my observation about September 1, 1916.

Family History.—Father died at sixty, the result of accident; mother, one sister and two brothers living and well.

Personal History.—Patient had the usual diseases of infancy and early childhood; pneumonia at age of thirteen, from which she made a satisfactory recovery. No history of later illness. Menstruation began at fourteen, regular, of the twenty-eight-day type, duration four days, always attended by sufficient discomfort to keep her in bed the first two days. She married at twenty-two, became pregnant three months thereafter, and was instrumentally delivered of a normal child at term after a prolonged and difficult labor. No other pregnancies and no miscarriages.

The patient stated that she was apparently in labor nearly two days before the attendant applied forceps and extracted the child, that she was extremely ill for six weeks thereafter, during which time she suffered from severe abdominal pain, with fever, etc. It seems probable that she became infected during accouchement or the parturient period. According to her statement she had never enjoyed entire freedom from abdominal distress since the birth of her child, and at times pain became sufficiently severe to confine her to bed. Under hot applications the pain subsided within a few days, and she was able to attend to her household duties until another exacerbation occurred. These attacks varied in frequency from three to five months, usually developing during or just prior to the menstrual period.

During the latter part of August, 1916, there occurred a particularly severe exacerbation, and I saw the patient shortly thereafter. She was then suffering from intense pain diffused over the entire abdomen; her pulse was 140, temperature 102° F., and she gave evidence of being extremely ill. Physical and bimanual examina-

tion unsatisfactory because of general abdominal pain. Sufficient evidence was obtained, however, to justify the tentative diagnosis of " acute exacerbation of chronic bilateral salpingo-oöphoritis with probably acute appendicitis," and the patient was sent to the hospital for an emergency operation about ten o'clock at night. After a general anæsthetic had been administered, more complete investigation made the diagnosis certain, there being noted a slightly mobile, sausage-shaped tumor upon either side of the uterus, which was immovably fixed in the pelvis.

Operation.—Celiotomy by six-inch median incision disclosed the pelvic viscera literally " matted together," so extensive and dense were the adhesions, separation of which required division or sharp dissection. After sufficient adhesions had been divided to permit reasonable exploration of the pelvic interior, a large pyosalpinx was revealed upon either side, one of which had ruptured and the pelvic cavity was filled with purulent material. Both ovaries were practically destroyed, and the appendix was acutely inflamed probably from extension of the infection. Both Fallopian tubes, the ovaries and the appendix were removed and drainage instituted without attempting to accomplish complete separation of the existing adhesions. Both rubber tubes and gauze covered with rubber tissue were employed for drainage in this case because of the large amount of pus present in situations which were inaccessible on account of existing adhesions. The discharge of pus in gradually decreasing quantity continued through the drainage tracts for nearly four months; otherwise recovery of the patient was uneventful.

Subsequent History.—Early in September, 1918, or two years after the events cited in the foregoing, I was again asked to see the patient. She then gave the history of having remained free from abdominal discomfort until a few days before my visit, at which time she complained of severe pain in the right lower quadrant with constipation which had persisted for four days despite the administration of purgatives and the employment of enemata. She had vomited twice the day I was called to see her. Recognizing the case as probably one of acute fæcal stasis, due to some mechanical cause, I considered it inadvisable to wait for the development of more characteristic symptoms, and the patient was taken to the hospital for immediate surgical intervention.

Operation.—Celiotomy, incision one inch to right of former oper-

ative wound; fæcal obstruction from two pencil-sized bands of adhesion constricting ileum about eighteen inches from ileo-cæcal valve; considerable distention of intestine proximal to site of obstruction. These small bands were divided and the denuded areas covered with omentum.   No other adhesions disclosed after careful exploration through celiotomy wound.   It may be interesting to note that in reaching the ileum a Meckel's diverticulum about one inch long with base much larger than the apex was discovered.   This was allowed to remain undisturbed, as I did not believe it would be the cause of any future trouble.   During the first twelve hours after the operation the patient was given frequent doses of oleum ricini and pituitrin. No untoward symptom developed following the operation, and the patient was dismissed from the hospital well in three weeks.

Comment.—The most interesting feature in connection with this case has already been mentioned in this paper, *i.e.,* the tremendous number of dense intra-pelvic adhesions which existed, and were allowed to remain unseparated during the original operation, had entirely disappeared when secondary celiotomy became necessary two years later for relief of fæcal stasis caused by two small bands subsequently formed, or by the contraction of scar tissue created during the resorptive process of preëxisting adhesions.   As previously stated, it is unknown why intra-abdominal and intra-pelvic adhesions disappear in one case and persist in others seemingly identical in every particular.   In this case the adhesions were so dense and extensive, and the amount of infection and pus formation so prodigious, that it is surprising that nature was able to successfully relieve the situation.

This is the first time in my experience that post-operative fæcal stasis requiring secondary operative intervention has developed after the patient left the hospital.   I have seen several, however, where post-operative obstruction developed from acute inflammatory processes before the patients were dismissed.   As has been said concerning the disappearance or persistence of adhesions, no one seems able to satisfactorily explain why acute post-operative fæcal stasis occurs in one case and not in others where all the surrounding circumstances and conditions are identical.   In the case reported the obstruction was due to bands of adhesion and not to acute inflammation.

CASE II.—Miss L. D., aged twenty-three, date of first observation, August 10, 1912.   The patient had been a *fille de joie* since the age of eighteen, and would impart no information concerning her family

and personal history. At the time I saw her she was writhing in agony
with her knees under her chin because of intense pain due to an
enormous pelvic abscess—so large, in fact, as to cause " bulging " of
the rectum at the anus. Immediate operation for purpose of drain-
age was advised, but the patient refused and insisted upon going
" downtown " the same afternoon. A few days later there appeared
abundant evidence to indicate that the abscess had ruptured into the
general cavity, and the patient was rushed to the hospital for
emergency operation late at night, her pulse at that time being 180
to the minute and scarcely perceptible.

Operation.—Celiotomy, median incision, viscera " matted to-
gether " from pelvis to umbilicus. Upon lifting one coil of small in-
testine pus " spurted " five inches high out of the incision because
of the tremendous pressure. Intestinal agglutination was complete
from the umbilicus downward. Carefully insinuating my fingers
through the adhesions to a point behind the uterus, a large
rubber tube was introduced; however, fearing this method of drain-
age might be insufficient, the abdominal incision was closed around
this tube without attempting further separation of adhesions, and
an incision then made through the vagina and another tube intro-
duced upward behind the uterus until the gloved finger encountered
the abdominal tube, thus giving the patient the benefit of drainage
both above and below. These manipulations were completed within
thirty minutes and the patient returned to bed. During the first
three hours after the operation the circulation was so feeble that the
radial pulse was imperceptible; but she finally rallied and improve-
ment thereafter was rapid. For about a week the stench from the
drainage material was so great that it could be noticed at the other
end of the hospital more than one hundred feet distant. Hot packs
were constantly used in connection with general supportive treatment,
and she eventually made a satisfactory recovery. She was informed
at that time subsequent operation for removal of the diseased pelvic
organs would be necessary.

There was no recurrence of abdominal symptoms until early in
February, 1913, at which time she returned complaining of pain.
There was also some abdominal enlargement, and I explained to her
that there was evidently a reaccumulation of pus and removal of the
diseased structures was advisable, to which she consented.

Operation (February 17, 1913).—Celiotomy, long incision at site of former wound; both Fallopian tubes, the corpus uteri, and major portion of both ovaries with large abscess sac removed. At this time not a single adhesion involving the small intestine was disclosed by careful inspection. There was a small adhesion about the sigmoid flexure which was not disturbed. Recovery was rapid and the patient was dismissed from the hospital twelve days after the operation, the ultimate result being perfect. She has reported to me from time to time since, and says she has menstruated occasionally (every two or three months) for one day, evidently from the stump of uterus which was left and the small portion of ovarian tissue. She has remained in good health since the operation.

Comment.—In this case, on account of the prolonged suppuration, the tremendous amount of pus in the cavity, the extensive agglutination of the viscera, and the extreme condition of the patient when subjected to the original operation, it seemed almost impossible that she could recover. The result merely shows what may sometimes be accomplished by the surgeon in forlorn and apparently hopeless cases.

The dense adhesions and the extensive inflammatory process present in the lower abdomen at the original operation absolutely precluded anything other than drainage without the infliction of perhaps irreparable peritoneal damage, yet when the abdomen was reopened six months later, not a single adhesion of the small intestine remained, and removal of the diseased structures was accomplished without the slightest difficulty.

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A GENERAL REVIEW OF NEOPLASMS OF THE CAROTID GLAND, WITH THE REPORT OF A CASE

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HENLE's researches have shown the existence in the economy of organs whose cells possess a great affinity for the salts of chrome. When placed in contact with a solution of potassium bichromate, they quickly take on an indelible brown stain. This affinity is quite special, and the reaction characteristic, so much so that Mulon does not hesitate to attribute a genuine determining value to it. Now, this chromaffin reaction is met with—in vertebrates in general and in man in particular—in organs which seem at first sight to have nothing in common with each other. Is there, consequently, a tissue so specialized that it could be described under the name of *chromaffin tissue,* as His has described the tissue of such a particular kind, under the name of *adenoid tissue,* and which is encountered in numerous organs? The following considerations will, I think, affirm this point of view.

The affinity for chrome is not a vulgar histologic reaction, and if one continues the examination of the subject more deeply it will be found that the cells called chromaffin possess two other reactions which permits classifying them in a well-defined group. Vulpian was the first to describe the reaction with perchloride of iron, which is particularly distinct in the suprarenals of cartilaginous fishes. The cells take on a grayish-green stain with this reagent, but in human tissues the stain is weak.

Finally, Mulon has described the osmic acid reaction. When exposed to the vapors of osmic acid the chromaffin cell stains rose which darkens, turns to red, brown or even to black, if the osmic acid vapors are allowed to continue their action.

Here, then, are three distinct and special reactions that are easy to reproduce, which are always identical in themselves in the cells under consideration. Is it to be concluded that the protoplasma of these cells contains a special and well-defined substance which always gives the same reaction?

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Since the discovery of adrenalin by Takamine in 1901, it is known that this substance—especially well studied by Fürth—enjoys a reducing power, thanks to which it precipitates in brown solutions of salts of chrome *in vitro* (*chromaffin reaction*), it reduces perchloride of iron producing a green color (*Vulpian's reaction*), and it reduces osmic acid on itself, taking a rose hue which turns to brown (*Mulon's reaction*). These three reactions encountered in chromaffin cells lead to the conclusion that they are characterized by the presence of adrenalin in their protoplasma.

Kohn was the first to call attention to this point; his histological researches tended to show that *chromaffin tissue* is a special tissue with a pure epithelial structure and the epithelial cells arranged in lines contain in certain spots granulations of adrenalin susceptible of staining brown, from which they derive the name of phœochrome cells.

The aspect of these cells is far from being always the same and lying beside light elements, very dark ones may be seen, according to Mulon; these different aspects certainly translate to the eye the variable states of repletion of the cell in secreted products.

Beside the phœochrome granulations, many other less characteristic forms have been described within the protoplasma of these cells. Laignel-Lavastine, Grynfeldt, Alezias and others have found vacuolæ which others have regarded as being an artificial product occurring in the preparation. Plecnick has described fat droplets in these cells in man. Pfoundler has demonstrated masses of figured pigment. But the essential character which gives to the chromaffin cell its special physiognomy is its adrenalin content and from this fact an important conclusion follows, which has been especially insisted upon by Langlois. The chromaffin tissue and therefore the paraganglions of which it is the substratum, are organs of hypertension, and, at the present time, are the only glands of the organism which certainly possess this action on the blood-pressure.

The remarkable experiments of Langlois introduced the notion into science of the existence in the suprarenal glands of a secretion capable of engendering arterial hypertension. Langley and Eliott soon afterward showed that this action was not exercised by the intermediary of the central nervous system as had been supposed, but by the intermediary of the sympathetic or unstripped muscle fibres.

Finally, Swale Vincent showed that these hypertensive properties

belonged to all organs containing chromaffin cells and Mulon estab-
lished beyond question that the *glomus caroticum* of mammiferous
animals is an organ of hypertension.   The paraganglions may con-
sequently be regarded as glands of internal secretion and they are
also in intimate relation with the vascular system.   The veins there
assume the sinusoidal type, which is often found in the neoplasms
which form the subject of this paper and the adrenalin-containing
cells are often only separated from the mass of blood by a thin layer
of endothelium.

The name of paraganglion which was given by Kohn to chromaffin
organs is fully justified, because the organs, no matter what anatomical
situation they may have in the body, have a constant relationship
with the nervous system.   Kohn has very properly pointed out that this
relationship is at the same time of a *genetic, topographic* and *his-
tologic* order.

In mammiferous animals, and particularly in man, the chromaffin
cells appear in the early rudiments of the sympathetic nervous sys-
tem.   It is known that the ganglions of the great sympathetic are
derived embryologically from the ventral extremity of the spinal
ganglions, which themselves are derived from neural or ganglion crest,
which runs along each side of the medullary plate and which, like the
latter, has consequently an ectodermic origin.

Now, the cells which compose the essential portion of the para-
ganglions are primarily comprised in the early embryonal development
of the sympathetic ganglions, and it is only towards the seventh week
that these cells (*Soulie's parasympathetic cells*) end their emigration
from the midst of the sympathetic ganglion mass to the paraganglion
which they compose.

But frequently nerve cells penetrate into the mass of adrenalin-con-
taining cells and here comes in the *histologic order* already referred
to.   The fact is particularly remarkable in the case of the suprarenal,
in which nerve trunks which have issued from the ganglion may be
seen included within the medullary substance, and traverse the corti-
cal substance of the gland in order to join the sympathetic system.

The topographical relations of the paraganglions with the sym-
pathetic are also important and are established by the fact that the
groups of chromaffin cells are invariably found in the neighborhood
of the sympathetic ganglia; however, the ganglia and paraganglia

usually possess a distinct individuality as they are each enveloped by a connective tissue capsule.

The chromaffin organs occupy a well-defined situation in the organism in any given biological group. For example, in birds they are scattered along the sympathetic, collected in the intercarotid gland and in the suprarenals in the form of cords or cells. In the mammiferous animals, the paraganglia, most important during fœtal life, persist in the adult, but with an attenuated function, and are principally found along the abdominal sympathetic of the aorta and the branches of its bifurcation.

In an adult human subject the organs classified as paraganglia are as follows:

(1) *The tympanic gland.* According to Mulon, it is situated along Jacobson's nerve and measures four millimetres.

(2) *The carotid gland,* situated at the bifurcation of the primary carotid artery.

(3) *Wiesel's cardiac paraganglion,* situated in the cardiac plexus at the point where the left coronary turns around the left auricle.

(4) *The aortic paraganglion or Zuckerkanell's organ,* situated on each side of the aorta at the point where the inferior mesenteric artery is given off.

(5) *Luschka's coccygeal gland,* situated at the tip of the coccyx.

The carotid gland was discovered by Haller in 1762, and was studied by Henle, Arnold and Luschka. In 1763, Sinitzer, of Copenhagen, wrote a monograph on this gland. Luschka described glandular culs-de-sacs in this organ—which in his day was called the carotid corpuscle—and thus made it a gland annexed to the sympathetic. Stieda believed that the carotid corpuscle was derived from a branchial cleft; Arnold insisted especially on the great richness of its vascular supply. Debierre maintained the same teaching and regarded the carotid gland as representing the remains of a vascular network which, in the lower vertebrates (amphibious animals) forms a portion of the second branchial arch.

Katschenko, Marchand and Paltauff likewise admit the vascular origin of this organ, but they suppose that it is derived from a proliferation of the walls of the carotid. Other writers, struck by the great amount of nerve tissue contained in this gland, regard it as a sympathetic ganglion.

Finally, Shilling, Kose and especially Kohn, noting the chrom-affinity of the cells of this organ, consider the carotid gland as being homologous to the medullary portion of the suprarenal gland and describe it under the name of carotid paraganglion. Mulon defended this theory and demonstrated by his experiments the hypertension action of the carotid gland.

Now, although this organ had for a long time an enigmatical signification, its morphology was nevertheless well known. Topo-graphically, the gland is not situated exactly in the angle of the carotid bifurcation, but rather *behind* it; therefore, it is retrocarotid or, more correctly, endocarotid in location. In shape it is oblong, its great axis being vertical. It measures from five to six millimetres in length and from two to three millimetres in width. Infrequently, it is divided into two or three quite distinct lobes. The organ is connected to the upper portion of the primary carotid by a kind of pedicle composed of fibrous and vascular structures; the pedicle is from two to three millimetres long and is attached to the lower pole of the gland. It is called Mayer's ligament.

The carotid gland is composed essentially by a connective tissue reticulum in the meshes of which masses of cells having an epithelial aspect are seen. These cells are very large, round or oval, but almost invariably polyhedrical on account of reciprocal pressure. They possess a special affinity for chromic reactions and are, in reality, chromaffin cells.

Besides the connective tissue and epithelial elements, the carotid gland possesses a rich network of capillaries with thin walls and irregular contours belonging to the variety of sinusoid capillaries. In elderly human subjects the carotid gland undergoes structural changes. The epithelial cells disappear, while at the same time the connective tissue and vessels undergo a process of hypertrophy.

The arteries supplying the gland start from the bottom of the bifurcation of the carotid, are four to five in number and enter the gland at its lower pole. There are three to four veins which make their exit on the opposite side of the gland and empty into the superior laryngeal, lingual and pharyngeal veins.

The nerves are very numerous and come from various sources, viz.: the sympathetic, pneumogastric, hypoglossus and glosso-pharyn-geal. The nerves reach the gland at its upper pole and their fibres—

with or without myelin—can be traced as far as the thin connective tissue bundles. Besides nerve fibres, the gland also possesses a few nerve ganglion cells, as is the case for all chromaffin organs.

Neoplasms of the carotid gland were, until quite recently, regarded as a real pathological curiosity, but during the past few years they have been studied and a number of cases have been put on record. One of the first papers on the subject, that of Reclus and Chevassu, in 1903, already had a series of eleven cases. In 1906, Keen and Funke were able to collect twenty-seven operated cases, while Douglas, who continued Keen's paper in 1909, added five cases, one of which was personal, bringing the total up to thirty-two.

In Licini's general review of the subject this writer published a case of his own not mentioned by Douglas, so that the total number of cases recorded in the medical press up to 1909 is thirty-three. Since this date I have been able to collect eight other instances, one being a personal observation from the service of Professor Faucon. One other case was reported in 1912 to the Medical Society of Jihloeosko-Zuojemsk by Kostlivy, but I have been unable to obtain any published report. My personal case is as follows:

Female, married, aet. forty-seven years, without pathologic antecedents, mother of three children, applied at the hospital for a tumor of the neck which first was noticed nine years ago during a pregnancy.

The tumor was the size of an egg and occupied the left lateral cervical region. It extended upwards as far as the angle of the lower jaw and downwards reached the upper border of the thyroid cartilage. Tillaux's line for ligature of the external carotid divided the growth in its long axis. Outwardly, its postero-external portion was covered by the anterior border of the sterno-mastoid muscle.

The integuments covering the growth offered a rather spread out cicatrix resulting from an attempt on the part of the patient's physician to remove the tumor seven years ago and given up as a bad job after the superficial structures had been incised. This cicatrix, as well as underlying structures, adhered to the tumor; when the sterno-mastoid was relaxed the growth enjoyed a certain amount of lateral mobility and did not appear to be adherent to the deeper planes of the neck. It was spontaneously painless, likewise on pressure and in consistency recalled that of a hypertrophied fibrous lymph-node.

The surface of the tumor was uniform, excepting at the upper

part, where two small rounded lymph-node projections, the size of a pea, could be felt. They appeared to be adherent to the tumor. There was no pulsation nor phenomena on expansion which might lead one to suspect a vascular tumor.

When the patient leaned forward to lift a weight or to pick up an object, the tumor became the seat of disagreeable sensations, but it more especially on account of its considerable development during the past few years thus decided the patient to have it removed.

Operation.—An incision was made from the angle of the jaw down to and below the upper border of the thyroid cartilage and the skin and superficial structures which were adherent forwards, were dissected off outwardly and backwards. In attempting to free the lower pole of the tumor a peculiar resistance was felt, and it was soon found that this resistance was due to a whitish cord, the size of an ordinary pencil, which ran up towards the anterior aspect of the growth and dipped into and became lodged in a deep sulcus in the tumor surface, where it became imprisoned and intimately adherent. This cord was nothing less than an artery which, when traced from end to end, offered no collateral branches.

Approaching the internal border of the tumor a fairly good-sized vessel was divided, but it did not have any relation to the above-mentioned vessel lodged in the sulcus on the surface of the growth, but it did appear to come from the growth directly.

The skin incision was then increased two centimetres downwards and then it was distinctly seen that the vessel first discovered was a continuation of the trunk of the primary carotid and could be nothing else than the internal carotid. The trunk of the external carotid penetrated directly into the tumor.

An attempt to free the upper pole of the tumor was not more successful, so the primary carotid was divided between ligatures, after which the growth could be raised up and completely freed after division of the facial and lingual arteries which emerged from the mass. The internal jugular vein and pneumogastric, pushed outwards and backwards, were not seen during this latter part of the operation. Hæmostasis was easy, the wound was closed with silkworm-gut and drained with it. Primary union in one week.

The post-operative period was perfectly normal and the only phe-

nomenon noted was an anæsthesia of the pulp of the right thumb one week after the operation, but which only lasted a few days.

Therefore, to date, I have been able to collect forty-two published cases of tumors of the carotid gland, and although I have gone into details rather long, it has been only to show that these neoplasms are not as exceptional as was formerly thought.

The causes which directly preside over the development of these neoplasms escape our knowledge and since no immediate cause could be found, the antecedents of the patient and the special circumstances which have accompanied or preceded the appearance of the growth have been carefully examined.

In my case, the patient distinctly stated that the growth first manifested its presence during a pregnancy, but I have not found a similar history in any of the published cases. Pultauf's patient had a tuberculous pleurisy, but this must be regarded, I think, as a mere coincidence, because in the majority of the reported cases no morbid antecedent is mentioned and it is often even stated that the subject was strong with an excellent state of health.

Reclus and Chevassu mention as probable factors buccal, dental or peribuccal inflammatory processes, and Von Heinleth's case seems demonstrative in this respect, because the tumor followed the extraction of a tooth which was followed by abscess. Whether or not such conditions are merely coincidences is difficult to affirm or deny, given the very small number of instances reported.

Conditions related to the patient's age have been more precisely indicated, and the following table shows the ages at which these neoplasms are the most frequently met with. Of the forty-one cases that I have gone over, the neoplasm appeared:

Between 10 and 20 years :	1 case	(17 years)
Between 20 and 30 years :	7 cases	
Between 30 and 40 years :	11 cases	
Between 40 and 50 years :	10 cases	
Between 50 and 60 years :	6 cases	
Between 60 and 70 years :	5 cases	
Between 70 and 80 years :	1 case	

Reclus and Chevassu were of the opinion that neoplasms of the carotid gland were tumors of young adult life, but it would appear from the data obtained from my investigations that these growths

occur at a more advanced age than was supposed by the earlier writers
on the subject. The greatest frequency is between the ages of thirty
to fifty, although Von Heinleth is of the opinion that these tumors
are more prone to develop at puberty at a time when normally the
gland should, in his opinion, undergo atrophy. Thus formed, the
tumor only presents an exaggerated growth of the normal carotid
corpuscle. This hypothesis does not seem to be justified by the facts
published to the present time.

The question of sex has likewise been differently interpreted. I
find nineteen males as against twenty-two females, so that the latter
appear to be a trifle more prone to this morbid process, but precise
conclusions in this respect would be, at least, premature, because, in
1908, Licini found fourteen males and fourteen females in a total of
twenty-eight cases that had been published up to that year.

As to the side the most frequently the site of these growths, here
are the conclusions which may be drawn from the cases so far reported.
The tumor developed on the right side in seventeen cases and the left
in twenty-three (in one case the side is not mentioned). Von Hein-
leth had already noted this prevalence on the left side and emitted the
hypothesis that this frequency was due to the greater obliquity of the
blood-vessels going from the carotid to the gland on this side, which
would provoke an imitation of the capillaries from a more violent
blood shock. Personally, I have no opinion to offer as to the exactitude
of these explanations, which are more mechanical in nature
than biological.

Neoplasms of the carotid gland all belong to a single type, un-
questionably with some variations, but not of enough importance to
cause the constant fundamental arrangement to disappear. But, as
regards the signification of these invariable arrangements, the opinion
of writers is extremely divided.

Before giving a summary of these opinions, I shall first describe
macroscopically and microscopically the ordinary types of neoplasm
of the carotid gland, taking my case as an illustration.

The specimen removed was the size of a small hen's egg and by
transparency was whitish. Firm in consistency at its postero-external
portion, the adventitia surrounded three small lymph-nodes, the upper
one being the size of a bean. The greatest interest offered by the
tumor resided in its relationship with the bifurcation of the carotid,

whose trunk and branches had been removed with the neoplastic mass which they traversed (see Fig. 1).

In point of fact the tumor had developed in the vascular angle on which it was astraddle, so to speak, its two lobes being nearly equal in size. Therefore, the primary carotid was overlapped on each side by these two descending lobes of the tumor. The internal carotid was deeply hidden on the posterior aspect of the tumor in a sulcus in which it was bound by an adventitia which could be readily stripped off and by a careful dissection the artery could be lifted out of its bed.

FIG. 1.
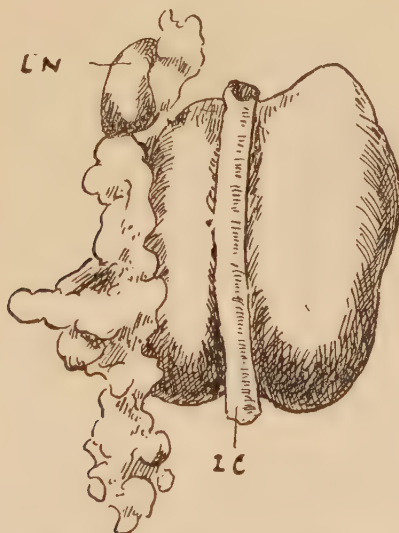
Tumor seen from behind. *L N*=Lymph node.
I C =Internal carotid.

On the contrary, the external carotid was situated in the very midst of the neoplasm into which it entered at the level of the emergence of the superior thyroid, whose curve, with the convexity uppermost, contributed with the carotid fork to bilobate the morbid production. The external carotid left the tumor at its upper pole before it gave off its second branch—the lingual artery. It would, therefore, appear that the artery had been elongated in its interthyrolingual trunk (see Fig. 2).

On section, the growth was composed by a rosy-white, dense, homogeneous tissue, having practically the same aspect throughout the

specimen. The external carotid could be seen gapping, and its walls appeared blended with the surrounding tissue. The lymph-nodes on section were macroscopically normal.

Microscopical Examination.—The specimen was first fixed in dilute alcohol and at the laboratory in 1 per cent. formol. A large number of sections were made from different portions of the neoplasm (see Figs. 3 and 4).

The structure is essentially the same everywhere, characterized by the presence of tracts of cells infiltrating the connective tissue. The

FIG. 2.
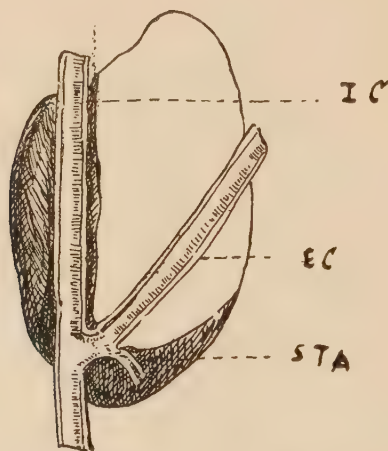
Antero-posterior section of tumor, showing the relationship of carotids to the neoplasm. *I C*=Internal carotid. *E C*=External carotid. *STA*—Superior thyroid artery.

connective tissue was the adult type and presented some rare cells and fibres which stained sharply with eosin. This tissue was very abundant in the central portion of the growth where it composed the larger portion of the tumor. On the contrary, at the periphery, it did not become engaged between the tracts of cells excepting in the form of very thin, fine prolongations.

The cell tracts were arranged exactly inversely. Extremely numerous and large at the periphery of the growth, they become dispersed in the centre, in the form of minute lines lost in the connective tissue.

No matter what was their situation and size, these tracts were

composed of large cells with voluminous nuclei, staining well with ferrum-hematoxalin. The protoplasm is vaguely limited and in places has an almost syncitial aspect. The cell collections are compact and are in reality solid tracts, and at no spot was I able to discover a perivascular arrangement described by the majority of writers on the subject (see Fig. 4). The only vessels belonging to the tumor were in the connective tissue and possessed well-defined walls. They were few in number, excepting at certain points of the periphery in the midst of the adventitia.

The defective fixation of the specimen immediately after removal prevented a proper research for the chromaffinity of the cells composing the tracts. Giemsa's stain, after a second fixation in Orth's fluid (formol and Müller's solution), uniformally stained the elements in blue and the connective tissue a pale violet.

Sections intersecting the region through which the external carotid travelled presented two peculiarities. First, the cessation of cell masses at the periphery of the normal artery whose external wall was intact, well preserved and even separated from the surrounding neoplastic tissue throughout the greater part of its extent simply from the microscopical manipulations.

Secondly, the preparations revealed the peculiar arrangement of the cell tracts at this point. They were numerous, large and separated by fine connective tissue tracts, as at the periphery of the tumor. It seemed that the peri-arterial area was a point of progression of the neoplasm in the same degree as the periphery. Sections of the lymphnodes revealed a simple hypertrophy, undoubtedly due to mere inflammation which had resulted from the first surgical attempt at removal.

Having now studied this concrete example in detail, I shall now pass in review the variations in the aspect of these tumors of the carotid gland. In all the recorded cases the growth was single and unilateral, while in size it varied from that of a small hazel-nut to a large hen's egg.

The consistency varies; hard in my case, it has usually been mentioned as soft or elastic, sometimes varying at different parts of the neoplasm. In one case particularly, that reported by Wooley and Free, it is stated that one of the poles of the growth offered a distinctly cystic feel.

The growth is usually dark colored or brown, but in my case it was almost white.

The seat and relationship are the most characteristic elements of the macroscopic pathology of these neoplasms. The normal carotid gland is situated at the postero-internal aspect of the carotid vessels. During the process of hypertrophy the organ overrides the vascular fork upon which it becomes placed astride.

All writers on the subject refer to the intimate relationship of the large vessels with the neoplastic production, but when one reads the case reports it seems that the large vessels usually are not included in the tumor mass and are merely embedded in a more or less deep furrow on the surface of the tumor.

In my case the contrary occurred, because the external carotid was intraneoplastic, surrounded on all sides by pathologic tissue, and I question whether or not this arrangement was primary, the result of an organ congenitally perivascular in development, or if a ring did not form secondarily by the two borders of the furrow becoming joined and welded together.

The lymph-nodes which are frequently agglutinated with the tumor are usually pathologically intact or simply hypertrophied, but two instances have been recorded in which they had undergone malignant degeneration, secondary to an atypical evolution of the neoplasm. These cases are due respectively to Kopfstein and Keen. In these cases the capsule of the organ, usually without adhesion to the surrounding structures, was infiltrated and intimately bound to them.

Macroscopical section of these tumors showed that they were composed by a homogeneous tissue with a varying vascularization and usually dark or brown colored or pale with a small vascular supply.

From the microscopic viewpoint, Reclus and Chevassu give a summary of the descriptions recorded up to the time of their paper and offer their personal opinion as follows: " The tumors are composed of two essential elements, of quite large cells, united in clusters, and vascular formations with thin walls limiting these clusters; thus a kind of alveola is developed. They (the tumors) also contain an accessory element, fibrous tissue which forms a capsule at the periphery of the tumor and in the centre surrounds the large vessels and sends off from the periphery into the centre (of the growth) a certain

Fig. 3.
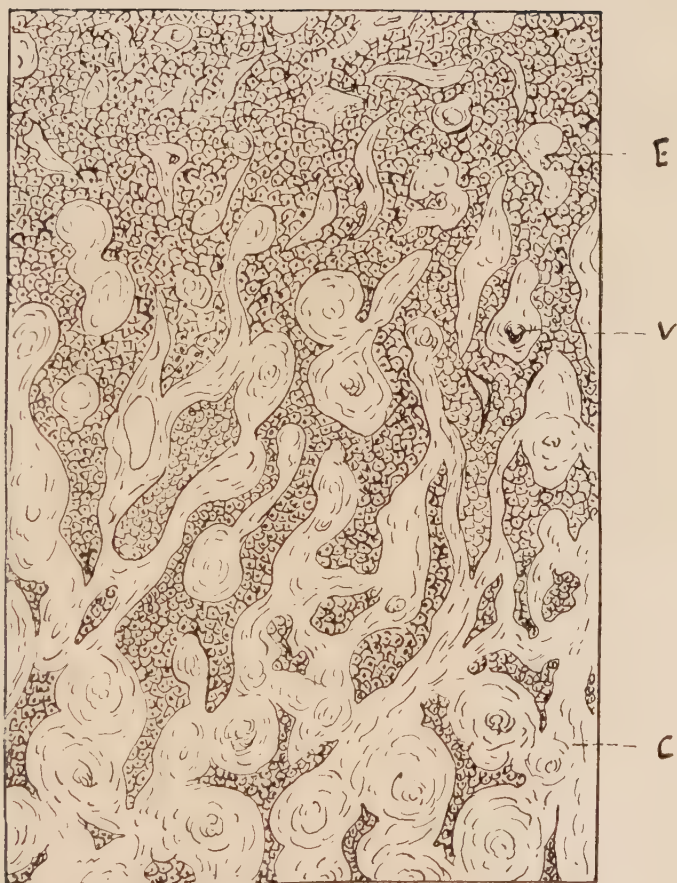
Microscopic section of tumor. Low power, showing the difference of structure at periphery and centre of the growth E, Peripheral epithelial tissue; V, Blood-vessel; C, Connective tissue in centre of growth.

Fig. 4.
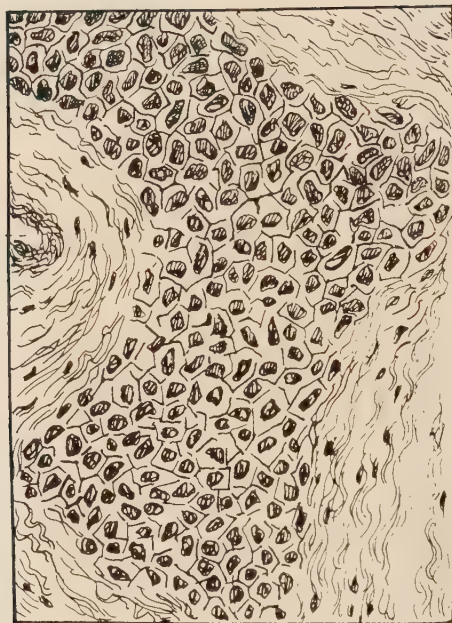
Microscopic section of tumor. High power, showing
in detail the arrangement of the epithelial cells and
connective tissue dissociated at certain spots. V,
Blood-vessel; E, Epithelium; C, Connective tissue.

number of tracts which very grossly divide the tumor into a certain number of lobes."

The fibrous tracts which divide up the gland are usually quite thick, although in some cases they were very fine.

The cells contained in the alveolæ are large, polygonal, with occasionally ragged outlines and possess a large nucleus which stains deeply with most stains.

The cells are grouped in more or less considerable number, according to the size of the mass which they form in the alveolæ whose walls are formed by capillaries, according to Reclus and Chevassu, or rather by endothelial cavities—angiomatous might be a proper name for them—" which form around the clusters of cells which they limit, a true capsule."

It is to be pointed out that the cavities of the endothelial spaces are usually empty and no red blood-corpuscles can be found. It is likewise to be noted that in any case the alveolæ containing masses of cells had no other wall than that which was formed by the connective tissue into which they were plunged. At certain spots I at first thought that I could recognize the arrangement described by Reclus and Chevassu, but in reality it was a condition caused by microscopical technic.

If, now, we sum up the various opinions regarding the signification of this pathologic tissue, it will be seen that the conceptions vary with those maintained in respect to the normal carotid gland. For Luschka, who first studied the organ histologically, it appeared to him that it was epithelial in structure and similar to the vascular blood glands like the suprarenal. But the majority of Luschka's contemporaries—among them Arnold and Eberth—regarded this gland rather as a vasculo-connective tissue formation.

Embryologically some regarded it as a branchial—epithelial—production, others as an endothelial formation derived from the adventitia of the carotid artery. Kohn, in 1900, seems to have settled the question in favor of the partisans of the epithelial nature of the gland by demonstrating the sympathetic embryonal origin of the cells composing the carotid gland which he unreservedly places in the group of chromaffin organs created by himself. Schilling disputed the honor of Kohn's discovery, whose value was later confirmed by Alezias, Peyron, Grynfeldt and others.

Such conceptions of the normal histology of the carotid gland naturally had their effect upon those of the pathology and here also we find two groups of opinion, namely, the partisans of the connective tissue theory and the partisans of the epithelial nature of neoplasms of the carotid gland.

Eberth and Paltauf, with the majority of the German school, accepted the connective tissue theory; some regarded these growths as peritheliomata (unified classification of Max Börst); others looked upon them as endotheliomata, and still others connected them with sarcomata.

For the French school the perivascular arrangement of the neoplastic elements would fall under the denomination of sarcomata (Brault) and the existence of peritheliomata is to be doubted from this very fact. Alezias and Peyron have shown from a very minute study of data obtained that the characteristic aspect of endothelioma, namely, " the progressive incorporation of the vascular endothelium into the various perivascular clusters or collars (of cells)," in no way implies an endothelial origin of the perivascular elements. These same writers have also proved that the evolution following the sarcoma type in reality represents a tumor composed of the parasympathetic embryonal type—fusiform elements with a finely fibrillar cytoplasma having a neuro-epithelial aspect—and merit the name of parasypathoma.

Finally, they have described in neoplasms of the carotid gland certain histological aspects, characterizing the metaplastic evolution of these neoplasms, called epithelioid, and which consist of " tubulated or lobulated masses with more or less accentuated keratosis succeeding the perithelial arrangements and commencing by a progressive disappearance of the vascular axes and the consecutive disappearance of the collars (or cells)."

I would point out that the notion of these epidermoid formations —keratosis with epidermic globes—offers great importance for the study of branchiomata which are possibly more common than has generally been supposed and perhaps some cases to which this term has been applied in reality belong to the pathology of carotid gland neoplasms.

The pathologic arguments—drawn from the epidermoid or parasympathic evolution—appear to distinctly establish the epithelial

nature of neoplasms of the carotid gland and, as a consequence, of the gland itself. But opinion is far from being unanimous in favor of this conception.

Nicoplende denies the chromaffinity of the tissue of the carotid gland and affirms that its pathology has nothing in common with paraganglions in general. Without making a formal decision on these various opinions, I nevertheless referred at the beginning of this paper to the chromaffin organs, and I did so because I desired to mark by this summary that, in the actual state of science, these subjects appear to be intimately connected.

The microscopical examination of my specimen did not allow me to place the chromaffinity of the cells in evidence. Chiari, for that matter, has vainly searched for it, but I would remark that the sections of my specimen distinctly offered the aspect of an epithelial cancer, and this seems to me to militate in favor of Alezias and Peyron's theory and the epithelial theory in general.

The most remarkable fact obtained from reading the case histories of neoplasms of the carotid gland is that the tumor has been developing for some time before the patient is aware of its presence or that they seek medical advice. Consequently, the onset is silent, while its duration will naturally vary with the rapidity of the evolution of the tumor.

Usually the patient distinctly states that it was merely by chance that he discovered a small " gland " in the side of the neck. It is while making his morning toilet or stooping to pick up an object or making some effort which puts the cervical muscles on the stretch that a sensation of tension is felt in the neck. It is not a real pain, but rather a feeling of discomfort, which causes the patient to feel of the cervical region, and it is then that the presence of a small induration is discovered.

The subjective symptoms are not usually remarked by the patient until the growth has taken on a certain development, but for that matter these symptoms are common to many growths of the region of the neck. There is a dragging sensation, some discomfort or indefinite pain vaguely localized in the carotid area, but there are instances in which the growth remained completely painless or after having remained perfectly indolent the neoplasm has suddenly become

very painful, so much so as to oblige the patients to seek immediate operation for relief.

Some patients have complained of tinitus aurium or dental neuralgia (Licini), while arterial pulsation and souffle, which are mentioned among the objective symptoms, may be felt by the patient either constantly or when certain special positions are assumed (Wooley and Free).

Finally, difficulty in swallowing seems to be a rather common symptom, and in one instance there was hoarseness. It would seem logical to regard all these signs as due to compression of the vessels and nerves of the region by the tumor, but it must be admitted that no one of them is characteristic and more precise and exact diagnostic indications must be looked for among the objective signs.

By inspection there may be little to be seen. In ordinary cases there is a slight elevation occupying the upper portion of the sternomastoid area. By placing the patient in a full light, with the head slightly extended, and looking at the parts directly in face, the extent of the deformity can be easily appreciated. At the same time, it will be noted in most cases that the tumor is raised by very distinct pulsations, synchronous with the pulse.

The tumor is not exactly superficial. It is separated from the integuments by the musculo-aponeurotic plane of the neck, composed by the sterno-mastoid whose anterior border obliquely crosses the mass formed by the neoplasm and which hinders palpation, even rendering it impossible if the muscle is not relaxed. Below, the tumor reaches between the sterno-mastoid and larynx and the middle portion of the thyroid cartilage in most cases. It extends upward towards the parotid space and may reach the angle of the lower jaw.

Bimanual palpation often shows that the growth when pushed back with one hand comes in contact with the walls of the pharynx. These tumors vary in size as already stated. The bosselated condition of their surface may escape notice, and to the feel it is smooth. In other instances this condition is quite appreciable to the feel.

The consistency varies, but in most cases the tumor was soft, occasionally elastic; rarely hard.

The pulsations are one of the signs which strike the examiner the most. Very distinct and readily explained from the situation of the tumor in the vascular fork which transmits its beats to it, they

are made to disappear by compressing the primary carotid. They are simple pulsations; there is no expansion, or, if there is any, it is very trifling and distinctly limited.

Licini describes a sign which he observed in his case and that might pass as pathognomonic of tumors of the carotid gland. If the tumor is seized with two fingers, one being placed on the antero-internal border, the other over the postero-external border, the fingers will perceive each pulsation of the carotid, the first that of the external, the second that of the internal carotid. It can thus be affirmed that the tumor overrides the carotid fork, but unfortunately this sign is not perceptible when the neoplasm completely encircles the carotid arteries.

Reclus and Chevassu have described another sign which also appears to be characteristic. If the hand is placed over the growth and it is pushed back for an instant and then the compression is suddenly stopped the tumor seems to have disappeared, but immediately afterwards it returns in one or two successive pulsations to its original size. The phenomenon was observed by Maydl, and the following explanation was given by Reclus. The pressure of the hand pushing back the tumor towards the pharynx carries the carotids along with it and tends to give them a curve with the convexity towards the pharynx. The systolic pressure tends to straighten this curve as soon as the compression ceases, and it is only after two or three beats that the tumor returns to its former position.

Tumors of the carotid fork are rather mobile transversely and completely immovable vertically—an evident effect of the connection of the neoplasm with the vessels which themselves are movable in the lateral direction but not in the vertical one.

The sounds revealed by auscultation over the growth are variable and may closely simulate those due to an aneurism. They usually consist of a systolic murmur which may be wanting, as in my case, when the tumor is very large, hard and not well supplied with vessels.

As a rule, tumors of the carotid gland grow slowly, and in most instances they have only been removed four or five years after their onset; in some cases the growth had been present for eight, nine or even sixteen years, and forty years in Von Heinleth's patient. Cases are uncommon where an operation was undertaken early in the process. In nearly all the case histories a remarkable fact is mentioned, namely,

that after a number of years—sometimes many—during which the growth had remained stationary, or nearly so, it suddenly began to increase in size. The reason for this sudden growth is still to be found.

In Kopfstein's and Maydl's cases, malignancy was unquestionable, since a lymph-node was almost entirely invaded by the neoplasm. Pagès, Alezias and Peyron have distinctly shown by their studies on the epidermoid evolution of these growths their malignant character, and in their preparations the walls of the carotid were invaded by epithelial elements. There are four cases on record in which a recurrence of the tumor took place after a careful dissection of the vessels in the tumor mass in order to avoid their resection had been done. Therefore, neoplasms of the carotid gland which were formerly supposed to be non-malignant should now be regarded as having a tendency to epitheliomatous or sarcomatous change.

The small number of exact diagnoses made of tumor of the carotid gland shows the real difficulty in practice of suspecting the true nature of the lesion. In order to reach a correct conclusion as to the nature of the growth, it is first of all essential to detect the carotid site of the neoplasm, or more precisely, that it is situated in a space formed by the sterno-mastoid region behind, the infrahyoid region in front and the submaxillary region in front and above.

Next, the relationship of the tumor to the neurovascular bundle should be made out. The growth, like the vessels, is movable transversely and being attached to the vascular trunks it is immovable vertically. The carotids transmit their pulsations to the growth and with it they can be pushed inwards towards the pharynx. The mass, composed by the growth and vessels, may offer a systolic souffle which confirms the intimate connection of the neoplasm with the carotids and should lead the surgeon to suspect a tumor of the carotid glands, while if the so-called Licini's sign is present—pulsation felt in front and behind the neoplastic production—there can be no question but that the tumor is intercarotid in situation.

But even when the relationship with the vessels is clear, hesitation is quite permissible, because affections of the lymph-nodes of the region are common, be they inflammatory or neoplastic, primary or secondary. Subacute adenitis, tuberculosis of the lymph-nodes or lymphatic involvement from pharyngo-laryngeal malignant disease

are what may be called vulgar affections, and growths of the carotid gland are rare.

By a very minute examination primary lesions of the tributary regions of the suspected lymph-nodes must be first eliminated and the condition of the tonsils, pharynx and larynx noted. Ordinary adenitis or tuberculosis usually involve several lymph-nodes at once and even when only one is especially involved infected satellites will be discovered. But lymph-nodes will be about equally movable in all directions and they are less intimately related to the arteries; it is the internal jugular that they accompany on its external aspect.

Lymphosarcoma and sarcoma of the lymph-nodes have a rather characteristic rapid evolution, while other non-malignant growths, such as lipoma, fibroma or enchondroma must also be considered when making the diagnosis.

If the tumor is soft it is probably an aneurism of the carotid and a sign that will usually prevent mistakes is the absence of expansion in the case of neoplasm of the carotid gland, which is the principal symptom of aneurism. Congenital or acquired cysts of the neck could never be mistaken for a growth of the carotid gland.

The treatment of tumors of the carotid gland is surgical, but the operation is a serious one, not only on account of possible hemorrhage, but more especially from the frequency of injury to the nerves, as well as the accident which may ensue from ligature of the primary carotid artery. In 1908, Licini found the mortality of operations on the carotid gland to be as high as 33 per cent.

Besides shock and hemorrhage, which have been mentioned in several cases as the cause of death, it appears that operative wounds of the pneumogastric have resulted fatally on account of the resulting bronchopneumonia, while death following ligature of the primary carotid has been due to cerebral lesions causing hemiplegia with aphasia.

An examination of the histories of the successful cases shows that the post-operative period was sometimes disturbed by temporary or permanent lesions, the most frequent of these being paralysis of the vocal cords and dysphagia, seven cases; deviation of the tongue, four cases; dilatation of the pupil, two cases; facial paralysis, four cases. In my case the patient complained of an anæsthesia of the right thumb (consequently on the side opposite the gland involved) for a

few days following the operation but the ligature of the primary carotid in this case did not give rise to any incident worthy of note.

What decision should be taken in cases of neoplasms of the carotid gland? When the tumor is small and the diagnosis perfectly clear, removal should be advised, remembering that at this phase of the evolution of the morbid process a dissection can be accomplished without much risk of wounding the vessels and nerves and that they probably will not require being resected with the tumor, but it must also be remembered that such cases rarely come to the surgeon.

Therefore, usually the growth is first seen when it has attained some size, in which case should operation be always advised? I do not think so. If the neoplasm has had an extremely slow evolution, if it causes no discomfort, and if it has not produced lesions by compression of the organs of the neck, it may be fairly safe to suppose that the growth is not malignant and that its removal is not necessary.

But if the tumor, after having been stationary for a long time, suddenly commences to increase in size, it is more than likely that an evolution towards malignancy has commenced and immediate excision should be resorted to.

As to the operative technic little need be said. It must of necessity vary with the extent and intimacy of the connections of the neoplasm with the vessels. The classical incision for ligature of the cartoid vessels has generally been sufficient in most of these operations, although occasionally more room will be required, in which circumstance a flap with its base adherent to the lower jaw may be made.

When the neoplasm has been exposed, the operator should recall that ligature of the primary carotid is, according to the saying of Farabeuf, " *an easy but dangerous operation.*" Therefore, a serious attempt to free the growth from the vessels should be made, and this is sometimes an easier matter than might at first appear, because the internal carotid is rarely comprised in the tumor mass, but lodged in a more or less deep furrow on the surface of the tumor.

When the growth is too adherent, the vessels must be resected with it, but even in these circumstances a careful and attentive dissection will prevent injury or division of the very important nerves.

Psychiatry

A REVIEW OF THE CONCEPT OF INSANITY WITH SOME INTERPRETATIONS OF ABNORMAL BEHAVIOR

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Sanity is a very difficult term to define. Speaking broadly, it may be said that the individuals who make an adjustment to their environment, pass a life-long existence in self-respecting and self-supporting usefulness, fulfilling the duties that fall to their lot, doing nothing to lose the respect of their fellow-men, may be said to be sane. In these individuals the conflict between desire and attainment has somehow been compromised and the result is sane and normal conduct.

Yet, insanity is still more difficult to define, for the different ways in which individuals may come into strife and conflict in the community, with their own best interests, and with the purposes of their existence, are much more numerous than those by which they may attain harmonious relations. Many definitions of insanity have been offered, but they are rather enumerations of acts that should be considered insane, from a legal, social or moral standpoint, than definitions of a concept according to its essential features and intrinsic meaning.

The term insanity is vague because it implies so much. A glance at the voluminous literature that has been written on this subject shows that the elastic term insanity may be applied to the genius and the imbecile, to the great philosopher Comte and to the idiot, whose vocabulary consists of two or three syllables. In recent years the concept of insanity has given rise to much popular discussion. This has been brought about by the fact that at the court proceedings in several murder trials some of the foremost American alienists held diametrically opposed views as to the mental condition of the guilty party at the time the crime was committed and subsequently. Yet it was

obvious that these mental experts were entirely honest in their opinions, even though they disagreed. Insanity is a legal and social concept and is used as a term to designate a group of individuals who are unable to adapt themselves to the requirements of society in which they live. The community segregates them, sometimes forcibly, and takes from them their rights as citizens. White says, " Insanity is a form of social inadequacy which medically may be the result of many varieties of mental diseases."

Insanity is a mental disease, but it does not embrace all of the mental diseases, nor are all of the mental diseases insanity. Thousands of people are suffering from mental disease that are not insane. They have not been declared to be of unsound minds by the courts. Included in mental illnesses are all diseases and defects of the mind as well as the more severe mental illnesses classed as insanities. All deliriums of children's diseases, of typhoid fever, pneumonia, Bright's disease, may become so pronounced as to be included among the mental illnesses. Insanity is a very elastic term, and sometimes it is difficult to distinguish between the abnormal and the normal mind, the demarcation is so limited. There is a gradation and continuity from sane to insane. It is absolutely impossible to find where sanity ends and insanity begins. There are all degrees of transition between calm, cold reason and the extremes of anger and passion, between originality and eccentricity, between genius and imbecility.

There is no individual whose characterological traits of personality may not become so exaggerated under the influence of disease or great emotional distress and worry, and, as a result a conflict may arise and produce conduct and behavior which is not accepted by society, and the law recognizes such conduct as insanity. Conduct is the basis upon which the community judges the individual. He may think as he pleases and the community has no interest in his thoughts, but he must act along fairly well-defined lines if he expects to be left unmolested. Insanity is a problem of behavior and to be crazy is to be many things.

Therefore, the class of mentally ill includes the various types of individuals who are unable to conduct themselves so as to make an adequate adjustment to their environment. This classification has a varied and extensive scope and may be applied to the misfits in society.

In St. Elizabeth's Hospital are held in more or less strict custody, groups of individuals who have for various reasons in some way come into conflict with the law or were unable to live in the community. They have lost their liberty and have been segregated not only for their own good, but for the good of society.

In this hospital are cared for patients who become mentally ill in the military services; the army and navy; Civil War veterans and Spanish American veterans; Public Health Service, including the coast guards; patients from the District of Columbia; non-resident vagrants, hoboes, and "White House cranks"; cases who come under the Women Welfare Workers of the police department; cases from the Juvenile Courts are often sent for observation to determine their mental condition before placing them on trial; all Federal prisoners who become insane while serving their sentences; all soldiers, sailors, marines, etc., in the military prisons who develop mental symptoms. These classes are all admitted under certain orders prescribed by law. Among the varied types of patients treated in St. Elizabeth's Hospital may be found the educated and the illiterate, individuals from the highest social positions in life to those from the lowest in the slums.

It is not an easy matter to present a case comprehensively unless the patient is present for observation, as they are presented in the clinics. No one can adequately describe the behavior, the facial grimaces and facial expressions of sadness, elation, ecstacy, the attitudes and postures of these people. Words cannot portray the pictures that are seen in the wards of a hospital of this class every day, nor can one who is not familiar with the behavior get an understandable idea of what those things mean to the patient herself or to the physician who makes a study of behavior from its biological aspect.

I have said that insanity is a problem of behavior. Let us take an example. The child playing in the street rolling his hoop is a common sight in our American towns or cities. No one questions this conduct, but accepts it as the natural outlet of childish energy. If a man should roll a hoop in the street there would be a crowd gathered around him in a few minutes which would interfere with the traffic. He would be arrested and placed under the control of the authorities because of this strange behavior. If a man were to be seen rolling a hoop on the grounds of St. Elizabeth's Hospital the physicians and

employees would not bestow a second glance on the man with his hoop, for they understand such behavior may be expected from a group of people who to a certain degree must be looked upon as children.

Perhaps one of the most extraordinary examples of abnormal conduct displayed by the women patients in their conversation is the inexhaustible flow of profanity and obscenity. This symptom is present in a large proportion of the insane, but more especially among the women. In the training of the little girl all tendencies to use vulgar or profane language are repressed, while the boy, unfortunately, is not supposed to be manly unless he can express himself in a few swear words. When the unnatural educational inhibitions in the woman are removed and she has mental disease she gives vent to all her repressions in language that would make a drunken sailor blush with shame. Such language from the lips of cultured and refined women is revolting to society and is not tolerated, but in an insane hospital employees pass along about their daily duties and are oblivious to such conversations. This language can be heard day and night in all parts of the hospital, but the trained attendant shows no reaction no matter how extreme the language may become.

In the behavioristic school of psychology which is the point of departure for the most advanced form of psychiatry or abnormal psychology of to-day, the attempt is made to study concrete examples and interpret conduct not from introspection but from objective behavior.

When the conduct of the individual is wholly at variance with normal standards it is assumed by the behavioristic school that there is a reason for this deviation. It is the aim of psychoanalysis to find this reason. In studying the behavior for the purpose the conflict comes to light in which the abnormal tends to replace the normal.

CASE I.—While visiting the wards a few days ago I noticed a woman of forty-five years dancing and singing; her facial expression was one of supreme happiness. She paid no attention to anyone nor did any of the other patients appear to be observing her. Inquiry as to what she was doing brought the response that she was playing that she was a little girl and having such a good time. She said, " Imagine that I am a little girl again in father's home and that I am with him." She said she had no children and no husband and that she was happy. Such behavior on the part of a woman of her age would be unconventional outside the hospital. Her behavior is understood in St. Eliza-

beth's and she finds no one interferes with her conduct and fancies she is happy.

Her history is: A married woman at the age of twenty-four to a man she did not love and who was not of her faith finds life very unhappy with her husband. He was a clerk on a small salary and three children added to the burdens of family life. After the birth of her last child she became excited, sang, talked loudly, struck her husband and accused him of infidelity, destroyed and upset furniture, threw the bed clothing out the window, refused to eat, and went three days without food. Was admitted to St. Elizabeth's; here she was excited and restless for a time, but after a few months she became quiet and finally made some sort of an adjustment to the situation and was discharged as a social recovery.

She was readmitted about six months later, in the meantime having received a limited divorce. She was more excited and noisy than on her first admission, but after a few weeks settled down to a happy existence in the hospital where she did light sewing and cared for herself. She had thrown off all the responsibility of wife and motherhood; had lost all interest even in her little boy who was only a few months old when she had her first breakdown. In her mental illness she is happy and contented.

Interpretation: A woman forty-five years of age; mother of four children, who does not love her husband but is very much attached to her mother and had depended upon her all her life. When her mother dies the painful situation becomes too great for her to bear and she develops mental disease to get rid of the responsibility. Her wishes, longings and day dreams which have been repressed and buried in the unconscious arise and are given expression in her delusions or false beliefs. She enjoys all her unfilled wishes in fancy.

She is a small, plain, unattractive woman physically. In her delusions she fancies herself most beautiful and attractive. All her life she was unable to have good clothing she craved and in her mental illness she compensated for this by decorating herself in gaudy youthful dress to satisfy these unconscious cravings. She imagines herself in her delusions to be powerful. From a low social position in life she assigns herself in her fancies to a position which she creates for herself that is higher than any earthly court. To acquire position and esteem she phantasies herself married to the President. A retir-

ing disposition and feeling of inferiority, she avoided appearing in public; to compensate for these qualities in her wish-fulfilling delusions she makes herself superior to any person on earth. Uneducated, she could not keep up with her classes in school and was indifferent to school life. She overcomes this defect by assuming that she is the most learned woman in the land and that she can understand all languages. Forty-five years of age she rejuvenates herself, fancies herself a young girl again, dresses as a girl, and behaves as a young girl.

Her husband's death frees her from a bond which is distasteful to her and which she feels is not for her best interests. She makes a recovery.

CASE II.—Young woman, aged twenty, exhibited the following behavior: Excited, danced, refused to wear clothing, tore up sheets and blankets, meaningless motions of her limbs, made speeches and was very noisy. Two weeks after admission, her behavior became normal, aside from the fact that she showed shame and humiliation for her unconventional behavior. At the end of two weeks was again excited, wrote many letters, magazine articles, stories and poems, numerous plays, made sketches in water colors, sewed, embroidered, worked at French translations, talked and laughed loudly. Then followed a severe excitement in which she sat upon the floor, refused clothing, tore up strips of blankets and wove them into fantastic savage dress and put them about her. Collected all scraps of paper, rags, and played with them, told of the wonderful uses she would put them to. Ran instead of walking (childish stage of regression).

Struck nurses and patients in the back, overturned furniture, untidy in habits. Interpretive dancing, became so restless was placed in a room with no furniture but a bed. Took the bed and banged it against the floor and blockaded the door with it, until it was taken out of the room. Tore a slit in the mattress, pulled out the hair, crawled in the slit. Tore colored strips out of the blankets and arranged them around her forehead in bands. Noted the most detailed actions of those about her but would not answer when spoken to and did not show she was aware that anyone was about. When no one was in her room she could be heard making speeches, singing, striking the wall with a sheet or a towel or her hands. (This she told later was to com-

municate with people outside who she believed were helping her to work out her problem.)

These excitements and quiet periods continued for several months and she finally recovered after she had reviewed all her mental illness with the psychoanalyst. She was able to explain her conduct and her problem which she believed she was working out and why she felt compelled to work it out in this manner. She went over her whole life with the analyst, her conflicts from earliest childhood, her strivings, her failures, etc.

Her difficulties were all summed up in a defect in her training and in the influences in her environment to which she failed to adjust. Her home training had a tendency to produce a feeling of inferiority. She had a poor inheritance, several of her father's relatives had been insane. Her parents did not understand her. Her sister had a better personality, was better looking, more attractive, and outdistanced her in her school work. All these conditions inculcated a feeling of inferiority and as she was unable to keep up with her sister she became discouraged, retreated into a world of phantasy and regressed to a lower childish level. While passing through her mental illness she would regress for several days to an infantile level then return to the level of an adult. She passed through these stages several times before she finally made a recovery. The explanation she gave of her conduct is most interesting, but it is too lengthy to give here. She said she would dramatize in fancy stories she had read. She imagined she was Guinevere at King Arthur's Court and her father played the part of hero.

This patient finds reality too severe and she tries to overcome all the personal weaknesses in her conflict. She takes on a child-like personality to escape from her difficulties. She made a recovery and is now a junior in one of the large universities and will probably take up social service work among the insane when she completes her course. She will be a valuable aid in this work, for she will understand these patients and will have much sympathy for them.

CASE III.—A young woman entered the hospital in an excited state. Her mother had just died; she felt she could not live without her. She had deep sorrow with depression, then an excitement in which she called the women doctors " mamma." She would not let her mother go out of her life, so she manufactured one. The nurses

and physicians are substituted for the real mother. She makes her adjustment at the level of a little child, she talks baby talk, carries a Teddy Bear around with her, yet she works all day efficiently and contentedly and is happy.

Case IV.—A woman, thirty-eight years old, domestic, plain appearance, appeared at the White House during President Roosevelt's administration and said she was the daughter of the President. She was brought to St. Elizabeth's.

After the death of Mr. Wilson's first wife a great many women came to Washington who claimed they were either his wife or that he had sent for them to marry him. Several of them were sent to St. Elizabeth's. During President Roosevelt's administration many men came from all parts of the country and said they were either the husband or fiancé of Alice Roosevelt, now Mrs. Longworth. We have now in the hospital two women who are Queens of Ireland, one was married in this country, but claims it through her husband's relationship. Another is in fancy a Danish princess, and still another is a Russian countess, and so on.

Why do these people entertain such ideas? All of them are below the ordinary type of individuals, and most of them filled the positions of menials. These individuals have none of the personal attributes, either physical or mental, that are associated with success in life; this essentially gives them a feeling of inferiority, yet their wishes and desires are the same as those of the most successful individuals. To overcome the feeling of inferiority they have all their wishes and desires realized in phantasies, and in the world of the mentally ill their ambitions and day dreams become reality. All these people manufacture relatives and believe they are born into high social positions. They cannot live happily in the real world; they build up an artificial world in which they can live. Their delusions show what they wish were true, and this new world bears them away from the world of reality; they are happy and genial and pleased with themselves and have a better time than if they were doing manual labor.

Interpretation of such behavior: The first few years of the infant's life the parents are supreme. They are practically the only ones in his environment. Father is powerful of all men. These are dominating factors in this mechanism. The father at this time is

incomparable. During the development of the child he compares his father with other fathers, and this comparison is often derogatory to his own father, for he sees him then in reality. When the introversion takes place and the individual turns back upon himself and regresses to a lower level in his existence, he reanimates his parents by bringing about a situation which is satisfying and which he wishes was true. He feels again what he did in childhood and again idealizes his own parents' and makes important personages of them. Often in this type of mental reaction the individuals develop the idea that their own parents are not theirs, but that they are the children of some one who is great and powerful.

Case V.—A colored woman soon after admission made a rag doll about the size of an infant which she called Nazareth. She said she had given birth to this child. It was the son of God; that she was a white woman. She said she had been sent to the hospital to save the " niggers " and recall them from their evil ways. She used to preach sermons to them every day, read the gospel and pray. She is in poor health and her eyesight is failing, and she now preaches her sermon and has her religious services on Sunday morning, while some years ago she also conducted an afternoon service on Sunday. When Nazareth wears out one part of his body she makes a new part; sometimes it is a foot or arm or a body. When he becomes unsanitary from too much handling she is told he must be done away with; she makes no fuss, but proceeds to make a new Nazareth.

This woman was married to a white man; when he died she became mentally ill. She fancies herself a white woman; she makes a white baby which in her phantasies gives her a higher place socially. She is all powerful, having the son of God as a son. A simple but happy way of getting rid of her difficulties, and reality.

Case VI.—Some years ago a man of considerable culture, college education and lawyer by occupation was received from the Federal prison at Fort Leavenworth. He was serving a twenty years' sentence for manslaughter. He had killed a man in Alaska following a verbal altercation. Under the intolerable situations and restrictions of prison life he developed mental disease. Was excited, aggressive, said he had not received a just sentence; that he was found not guilty and it was through a mistake that he was in prison. He said that he had been appointed Attorney General in Taft's cabinet and

he was anxious to take up his duties. He was aggressive and inaccessible and difficult to manage, for he believed that he had really been appointed to the position of Attorney General. He wrote numerous letters to his friends requesting their aid to obtain his release and aid him to assume the place in society to which he was entitled. It can be readily understood how difficult it is to deal with a man who entertains such ideas, especially when he must be kept under confinement. His friends obtained a pardon for him from President Taft, but his mental condition was not altered. He was considered a dangerous individual.

About one year ago one of his sons, who had become successful and prosperous in business, visited him. They went over the ground of his peculiar ideas and how unreasonable they all were. His son promised him a comfortable home when he was well. The improvement began from that time on. His son called at the hospital for him about one month ago and his father had improved to such a degree that it was thought advisable to discharge the patient to the care of his son.

This type of reaction is called a prison psychosis, or a situation psychosis. The painful situation in which he is placed in confinement is unbearable. He leaves a wife and young children without any provision for their support, while he is compelled to serve a sentence which he feels is unjust. He gets rid of reality and phantasies himself in the highest legal position in the President's cabinet. In this way he makes the situation more bearable and acceptable although he was never able to become happy to a degree in which he did not feel a certain amount of humiliation in the situation in which he was placed.

All of these patients reveal in their delusions and hallucinations their innermost desires and cravings. They believe in their cravings for power that their yearnings have been realized; that their ungratified desires and ambitions are attained; their wishes fulfilled and they assume an imaginary state of things in which such were the conditions. These patients were unable to have the things they craved, and the wish, volition and imagination in coöperation with the unconscious makes a world of fancy appear a world of reality.

These wishes may all be resolved in forms of primary cravings of the organism. It supposes the primary mental positions of earlier

periods of life and the modes of adaptation fitted to them do not
cease to exist when the individual ceases to use them. They are
merely thrust back into the unconscious, or repressed by the higher
types of adaptation. In the adult, the form of adaptation he had in
childhood still exists, and when some mental conflict renders normal
adjustments impossible the adult reacts to the form of adjustment
belonging to the earlier periods of existence.

The child at play imagines itself a man or a woman. This
may be seen in the analyses of the type of adjustment of the insane.
In the child mind, when consciousness has not reached its full func-
tion, the wishes are realized in day dreams. In sleep, when con-
sciousness is in abeyance, the sub-conscious gains ascendency and the
wish finds fulfillment in the dream. In insanity, where disease
reduces the higher conscious powers, the whole life becomes the
realization of the dominant longings.

In the growth and developtment of the individual, he must neces-
sarily find many obstacles in his path. As the obstacles with diffi-
culties arise they must be dealt with in a variety of ways. The
individual may deal with them successfully, or he may fail in his
attempt to deal with them, or he may make a compromise. The
successful manner of dealing with them brings pleasure and satis-
faction; failure brings disappointment and distress.

The mind that reaches the highest perfection in its development
intellectually is capable of the greatest latitude of adaptation and
enables the individual to adjust to his environment and fill any
position in which he may be placed.

Every individual has his limitations of the mental processes,
and any interference in these limitations by stress or worry will
cause a maladjustment and bring about conduct to such a degree as
to seriously interrupt or impede his relations in society as a
social unit.

Each individual has his problems to solve, moral and social.
He assumes an active part in his environment and endeavors to
shape it to his needs and plan of life. He tries to use the world as
he finds it, according to his wishes and desires, but as his wishes
and desires are the same as the wishes and desires of those about
him he must learn to modify his behavior and limit his pleasure to
the demands that society makes upon him. Hence a conflict ensues—

not necessarily a conflict with his associates, but a conflict of impulses within himself, between the desire-impulse and the fear-impulse, between the wish to attain and the fear of pain which accompanies failure. This internal conflict may hamper the fullest expression of self. The behavior exhibited during these conflicts is indicative of the individual's reaction under stress and deep emotion. This reaction under stress is modified by the personality of the individual. This behavior or type of reaction displayed under stress is a criterion of sanity or insanity. There is no sharp dividing line between the two, where sanity leaves off and insanity begins.

It has been said that the problems of mental disease are not very different from the problems of physical disease or internal medicine. For instance, if a man suffers from typhoid fever, which is due to a germ or bacteria outside the body, the symptoms manifested are the results of the fight set up by the body against the invasion of the body by the germ. The body makes a defense, and the symptoms, fever, pain, headache, nausea, sleeplessness, etc., are indicative of the defense of the body against the foreign bacteria. If the bacteria is of a weak variety, the patient conquers and gets well. He may not entirely recover from the fight, for he may be left in a weakened condition for the remainder of his life. Failure of the defense may cause death.

The symptoms of the typhoid are but the reaction which the body sets up against the invasion of the germ. All symptoms act for the best interests of the patient; the fever, pain, nausea, etc., keep him in bed and afford him the necessary rest for recovery.

The mental symptoms in insanity are the reactions which the mind manifests in the mental conflict in its defense against psychological difficulties which the individual has attempted to overcome in his daily life. These symptoms are the delusions, hallucinations, depressions, excitements, together with the social conduct and behavior.

The mental disease consists in fear or other distressing emotions which give rise to the psychological conflict calling forth the defense; and the defense which is set up against the invasion of the severe emotional distress is analogous to the physical defense against the foreign bacteria in typhoid fever.

All troubles of either mind or body should be discussed from the same standpoint, their reactions against invasions or difficulties. The

mind is made up of many parts. What we know as consciousness does not make up the whole of the mind. It is but the surface of the mind. By looking at the surface of the body we can have no adequate conception of what lies beneath the skin. For instance, in surgery, to be a good surgeon, one must have had a knowledge of the different parts of the body. He must have dissected a body. He must have studied embryology, histology, pathology, physiological anatomy, comparative anatomy and even paleontology in order to have the knowledge to do a successful operation for appendicitis. So it is with the mind. If you look at the consciousness you would know about as much of it as the surgeon would about the body if he only knew about the skin.

Every expression of the mind has a motive behind it. Every idea, impulse or feeling that appears in our consciousness is motivated by some experience that has gone before. Ideas cannot exist alone. All mental activity has its cause and explanation. None of the phenomena of the normal or abnormal mind can be regarded as the result of chance. Every irrelevant remark, all absurd delusions exist in the mind because of past experiences in the life of the individual. The delusion or morbid idea arose because of a conflict in the mental life between the desire and the attainment. The expression and productions of the insane can only deal with material at hand or the experiences that have gone before. Every delusion or hallucination expressed by the abnormal mind has arisen from the past of the individual and expresses his wish-fulfilling desires and the instinctive cravings of the soul.

In every individual there are more or less distressing conditions to which he does not care to yield. These tendencies bring about a conflict in the moral and social world and in the individual himself. The conflict brings out various defenses. To illustrate: a hospital employee, sorely tempted to relieve his financial distress, is torn between the desire to yield to temptation, which would relieve him of his serious difficulties, and his moral training. In the struggle for existence with the high cost of living, he finds his wife and children deprived of many of the comforts that he desires to provide for them. In his daily work he is surrounded by an abundance of supplies of all sorts and if he helped himself to them he would be able to relieve his distress. A serious conflict ensues which may end

in one of four ways, *i.e.* (1) If he is strong he will not yield. (2) If he is weak he will yield to temptation and help himself to the hospital property and get into difficulties. (3) He may leave the hospital and take up different work with an increased salary. (4) He may remain and take up additional work to assist him in his difficulties, financially.

DEFENSES TO MENTAL CONFLICTS

Mental symptoms express the reaction type which the individual shows in dealing with his conflicts. They are the symbolic language of the unsatisfied, instinctive desires translated into "motor sets." There are two ways of dealing with conflicts. First the flight into reality, second the flight from reality.

The flight into reality results in increased activity. The young woman disappointed in love goes into a round of social activities and therewith she drives the troubles out of her mind by taking a flight into reality and plunging into other interests. She is occupied with external interests. Her ideas change their direction at every point. She passes from one interest to another to forget her grief and keeps up a constant whirl of activities.

The case is cited of a private first class in the A. E. F., a splendid physical type of American manhood, during rifle practice in England before going to France, received the name " gunshy Jones " because he showed that he was afraid. Then in France under German fire he was seen running and avoiding all places of exposure on the firing line. He was demoted for this conduct and a few days later he was sent back behind the lines suffering from mental disease and in a very excited condition. This man suffered from fear and his delusions were as follows: He said he was a very brave man—he said he was a colonel and he made one of the colonels in the medical corps salute him—he said he wanted to be back in the firing line. This was his flight into reality. He was aware that he was afraid and his unconscious wish was to be brave so that he could be back in the firing line; that he could be promoted to a colonel. His unconscious ambitions were for powers and social esteem.

A young Jewish woman, handsome, married; during her girlhood, deprived of pretty things which young girls crave so much, by the poverty of her parents; during her married life denied her-

self all luxuries that her husband's business might prosper. Suddenly her father, mother, brother, and husband all died within a few days of each other from the influenza. She is prostrated with grief. She flies from her sorrow into the confusion and excitement of business life. She believes herself capable of earning great sums by buying and selling on the commission plan. She buys hats, coats, automobiles in great quantities, even squandering her child's legacy left by her husband. She would take no advice from anyone. Flew at her friends in a rage if they suggested advice or if denied anything. Ordered everyone about; was loud and boisterous in her manner; was irritable and angry without cause; wrote innumerable letters, sent numerous telegrams to various people and various addresses. In this manner she attempted to escape from her sorrow and forget by a flight into reality. All of the above are examples of reaction by extroversion.

In each individual there is a tendency to fear when confronted with the necessity of taking direction into unknown channels. He approaches it with timidity, is anxious and fearful. The unknown excites apprehension. Certain personalities can not adjust to new situations. They are incapable of overcoming fear. They find it more satisfactory to remain in the region of the known, than to venture into the region which is unfamiliar to them, the unknown.

Example: A young man to satisfy his parent's ambition studied industriously and passed successfully the examination for the Rhodes Scholarship. However, when the time came for him to depart for England to take up his studies, fear and apprehension assailed him. The region of the unknown became a terror to him. He could not leave the protection of his parents, and to satisfy this unconscious wish, he develops mental disease where he regresses to a childish level to escape reality and to remain in the region of the unknown.

Many of the young men after enlistment or induction into the army in the World War developed mental disease as a defense against reality. Some developed it before they arrived in the camps; others after arriving at the camps; others at the port of debarkation; others in England; again others in France; none of these were at the front. The region of the unknown was too much for them to struggle against and they have mental disease, regress to a level where they must receive

the care one must give a child.   This level of childhood which they reached is less developed and did not require responsibility.

Another example: A young woman following the death of her child goes back to a period antedating the unbearable emotional experience and becomes again, as it were, a young child herself, with, therefore, all knowledge of the experience of the death of her child effaced from her memory.   She reverts to a childhood level with the whole period of her married life and motherhood actually wiped out of her memory.   These are examples of reaction by introversion, a running away from reality.

TREATMENT

It is more important to prevent such types of reaction in individuals than to treat them after mental disease has developed.   Preventive medicine is the specialty that should be emphasized to-day, and the mental training and environment of the child should receive attention from the earliest moment of its life.   The mental hygiene movement has made great advances in the past decade to protect the mental health of the children and to avoid improper management of the young child.   Children should be given opportunity for a variety of wholesome activities and interests.   They should be taught some useful employment suitable to their liking, but they should never be fatigued.   They should be taught obedience, religion, and their energy should be directed into useful channels and interests outside themselves.   All forms of self interest and selfishness should be avoided as well as other introvertive tendencies.   All tendency to produce precociousness should be avoided.   When children experience early difficulties of adaptation, nervousness in its various forms, as a shut-in type of reaction, sleeplessness, emotional storms, irritability, persistent delinquencies, a competent physician should be consulted. We must not forget that improper home environment and training do much to produce mental ill health.

In the psychoanalytic treatment, which is a method of mental analysis employed at St. Elizabeth's in treating the diseased mind, the psychoanalyst with the aid of the patient interprets the symptoms, sometimes the dreams, manifested in each individual case and by winning their confidence and directing the energies into channels of usefulness either into healthy employment or in altruistic sublimation

in its various forms. To reach the patient successfully the approach must necessarily be at the level to which the individual has regressed and the patient should gradually be made to understand the fundamental causes of his failure to adapt to life. On writer in discussing the psychoanalytic method states: " Psychoanalytic procedure, employed in the interpretation of dreams of any person, can be called a scientifically organized confession that traces out with infinite patience even to the smallest ramifications the spiritual inventory of what was tucked in the mind of the person undergoing it. Psychoanalysis is used in medical practice to discover and relieve the spiritual causes of neurotic phenomena."

The psychoneuroses have been successfully treated by this method of psychoanalysis, but it is a new order of things to apply this treatment to the patients suffering from the psychoses. The patient suffering from the psychosis does not want to recover; he resists the treatment. He has found a comfortable level at which he can live and be happy in a world of fancies, he no longer has to assume social or moral responsibilities in a world of reality and his desire is to remain in this world he has established about himself. In the regression some of these patients have reached a childhood level; others have regressed still farther to an infantile level and have shut out of their lives the whole past by a process of forgetting. In the treatment each patient must be reached at the level to which he has regressed and gradually reëducated to a more normal mode of adaptation until he can accept the world of reality once more.

The religious sublimation for the world seems to be the most satisfactory one and the most enduring. This mode of adaptation has been accepted by all physicians and teachers as the most potent for holding the unstable character within the limits of accepted standards. Freud has said that with the decrease of religion there is an increase of the psychoneuroses. The great Pinel over one hundred years ago foreshadowed the view of modern psychiatry. He stated, " Insanity is at times due to both lesions and original predispositions, but in most cases it is due to moral affections." The psychiatrists of to-day thus find verified to a certain degree the subtile speculations of these learned men of ancient times who regarded such disturbance as disease of the soul. No matter what concept may be had of the word soul, it is certain that moral affections are the most frequent cause of mental

disease. The environment and early training, both social and moral, which the young boy and girl receive will have a marked effect on their successful sublimation in life. When, as a result of defective training, the neuroses and psychoses appear, the psychoanalyst must seek the innermost thoughts and feelings to discover wherein the training in the home failed, and with this information seek to bridge the chasm and restore to the patient as far as possible what he has lost or failed to receive during the developmental period.

Many of these patients, especially those whose mental illness is due to organic causes, are never able to take up their life again, but make a good adjustment on a lower level in the hospital, where they carry on their dream world undisturbed to the end of their days. They are happy and contented in this phantasy world which they have built up as a flight from problems that were too painful for them, and are examples of the truth of Dryden's lines:

> " There's a pleasure in being mad
> Which none but madmen know."

In conclusion, sanity may be said to be the ability of the individual to adjust himself to social conditions.

There is no distinction between the mind and body in its reaction.

The sphere of our consciousness is but the surface of the mind, just as the skin is the surface of the body. No two people look alike, but the structure underneath is alike. So it is with the mind.

Insanity is not a medical, but a social term. The word insane means little with the exception that it refers to a certain group of people whose conduct is such as to offend society at large and who are therefore deprived of their citizenship and segregated. The more highly organized the society the less the amount of freedom for the individual.

Pædiatrics

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LECTURES ON TUBERCULOSIS IN INFANCY AND CHILDHOOD

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Lecture I

GENERAL CONSIDERATIONS

It is unnecessary to quote statistics as to the prevalence of tuberculosis other than to state that in the last Annual Report of the National Tuberculosis Association, the death rate from all forms of the disease is placed at 150,000 per annum, with the estimate that there are at least 1,000,000 active cases and probably 2,000,000 unsuspected cases in the United States. In hospital practice Nagele found that after the age of thirty practically all bodies at autopsy show some signs of tuberculosis. In the population at large, it is usually estimated that from ⅓ to ½ of all adult individuals are infected.

HISTORICAL

In Cornet's treatise on tuberculosis in Nothnagel's Encyclopedia we find extensive references to the development of our knowledge of the disease. As far back as 460–366 B.C. appeared a classical description of phthisis by Hippocrates which, in many ways, can scarcely be improved upon to-day. He regarded it merely as a suppurative process in the lung. Smith and Ruffer have described lesions of Pott's disease found in an Egyptian mummy of the period about 1000 B.C. Not until the middle of the seventeenth century was there any notable advance made in the knowledge of the true pathology when Sylvius (1614–1672) first insisted on the relationship between the pathological tubercle and the lesions of pulmonary phthisis. The tubercles he considered to be enlarged lymph glands which were

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dependent for their development upon hereditary predisposition. Morton (1689) first noted that the tubercles were the necessary antecedents of the ulcerative process. Morgagni (1672–1771) first disputed Sylvius' belief as to the glandular nature of the tubercles. In 1700 Magnetus described miliary tubercles, but this apparently received no general recognition until Stark in 1785, again recognized their significance. Bayle (1774–1816) first followed the development of the millet-seed nodules to caseation and softening and concluded that phthisis was not limited to the lungs. He considered it a constitutional disease dependent upon the tuberculous diathesis. Laennec (1781–1826) taught that every phthisis developed from tubercles and therefore that the two were identical. Both Laennec and Bayle concluded that ordinary inflammation had nothing to do with the etiology of phthisis. Most authorities at that time insisted upon the importance of dyscrasia. Virchow (1847) considered caseation as retrogressive metamorphosis and believed that tubercles could also undergo calcification and fatty degeneration. In 1847, Buhl determined that active miliary tuberculosis was, as a rule, traceable to pre-existing cheesy foci, disseminated by the blood. The identity or nonidentity of scrofula and tuberculosis was contested—chiefly by Laennec and his followers on the one hand, and by Rilliet, Barthez and Cruveillier (1862). Even in 1771, Morgagni believed that phthisis was infectious and this belief has never since failed of a following among physicians.

Early attempts to inoculate human beings and animals with scrofulous pus were failures. Klencke in 1843, was the first to inoculate rabbits, in their jugular veins, with cells taken from miliary tubercles, with the result of causing widespread tuberculosis in the liver and lungs. The significance of this apparently was not recognized at that time by Klencke or others. In 1865, however, Villemin again successfully inoculated rabbits with tuberculous material but failed with non-tuberculous pus. In spite of the basic importance of these findings, it was not fully appreciated for some years. Langhaus first recognized the significance of the giant cells which had been described by Rokitansky and Virchow, but determined that they did not hold a pathognomonic relationship to tuberculosis as they were found also in non-tuberculous tissue. Friedlander in 1873 first determined the identity of local tuberculous lesions such as lupus.

As might be expected the attempts to discover the essential virus were numerous but none was successful until 1882 when Koch published his postulates.

DEATH RATE

One of the most important facts with regard to tuberculosis, is that the death rate is undergoing a definite and apparently consistent fall. The figures from the Registrar General's report in England since 1865, show that the decline has been almost constant. From that date until the present, the actual decline has amounted to 20 per cent. and the relative decline in proportion to the increase in population has amounted approximately to 50 per cent. Even with full allowance for errors in diagnosis which would increase or decrease the figures, the fall of the death rate is too marked to be attributed to anything but an actual decline in the number of fatal cases of tuberculosis.

As this diminution in the death rate began almost twenty years before the discovery of the tubercle bacillus and almost forty years before the growth of the Sanitarium movement, it is clear that it is owing to causes other than the anti-tuberculosis crusades of the last two decades. In fact, as Karl Pearson points out, the decline in England was much less rapid in the period from 1895 to 1910 than in that from 1847 to 1895.

Cobbett believes that there is no positive evidence whatever to show that the tubercle bacillus has lost any of its virulence. It is also true that in certain countries, *e.g.,* Norway and Ireland, the mortality from tuberculosis has actually increased. In all probability this is to be explained on economic and sanitary grounds; and increased virulence of the strains of tubercle bacilli encountered in those countries cannot be invoked in accounting for the difference in mortality.

Another theory to account for the decline is that of " racial immunization " by means of which families that show susceptibility to tuberculosis are weeded out, leaving more resisting stocks. In this phenomenon the eugenist Karl Pearson believes the ultimate explanation will be found. Cobbett points out, however, that although this weeding out of susceptible stocks doubtless has been operative for many centuries, its action must have been very gradual in the case of

such a disease as tuberculosis, which has been known since the earliest times of recorded history, and cannot account entirely for the recent marked diminution.

Cobbett believes that another kind of racial immunization, however, has been going on which may be a factor. As the population of countries tends to congregate more and more in cities, in close contact with one another, it is probable that there has been a marked increase in the number of infected individuals. Many of these infections become quiescent and render that individual, to a certain extent, less susceptible to re-infection. It has been objected that such immunity is short lived, judging from the results of artificial immunization of animals. It is undoubtedly true, however, that opportunities for re-infection are constantly obtaining with the possible effect of renewing the immunity thus created.

In England the increase in urban population began before the registration of causes of death became general, and Cobbett advances the theory that it is possible that such overcrowding in the cities at first was followed by an increase in the spread of tuberculosis and a corresponding increase of the above mentioned minimal immunizing infections; the latter, in turn, may then have led to a decrease in the fatality of tuberculosis. In this way he thinks we may be reaping the advantages which have followed a period of great activity in the disease. If this be true we might expect the present decline to be followed by increased mortality unless new factors of protection intervene.

The third and most important factor to which the decline has been attributed may be described under the general head " amelioration of social conditions." Under this should be placed all improvements in housing, dietetics, hygiene and sanitation which the last half century has witnessed and which have been so much accelerated since the discovery of the tubercle bacillus.

TYPES OF BACILLI

Three main types of tubercle bacilli are found, which differ very definitely in their cultural characteristics and pathogenesis; to a much less extent morphologically. The types are known as the human, the bovine and the avian. While atypical strains undoubtedly exist, it is usually possible to determine a clear-cut distinction between

the different types.   Human beings seem to be practically immune to the avian bacillus; adults are almost immune to the bovine bacillus, while both children and adults are susceptible to the human bacillus.

Human and Bovine Types.—As early as 1868, Virchow insisted that human and bovine tuberculosis were different diseases. By the close of the nineteenth century it was generally admitted that their differentiation was justifiable. Pathologically, however, there seems to be no difference in the lesions produced by either type.

In the determination of the type of the infection by the study of the bacillus, great care must be exercised to recognize mixed infections, where they may exist, and to be assured of the purity of the strains. For this reason many of the published reports of differentiation of the two types, based on cultural characteristics without animal inoculation, must be ruled out. Cobbett in England and Park and Krumwied in this country have published tables showing the percentage of bovine and human types of infection at different age periods. In the main their results agree and as Cobbett has included in his figures the results of Park and Krumwied's own investigations we may utilize his tables. Cobbett's series was based solely upon examination of tubercle bacilli recovered directly from the tissues.

Cobbett found that only 6 per cent. of primary pulmonary tuberculosis in children, up to twelve years of age, was due to the bovine bacillus. Among adults, 100 per cent. of cases were due to human bacilli. Primary tuberculosis of the bronchial glands, without any but, the most trifling involvement of the lungs or other organs also showed about 6 per cent. of bovine type of infection in children. Where there were two or more groups of glands involved, 27 per cent. were of bovine origin.

In cases of general tuberculosis without meningeal involvement, in children from five to sixteen years of age, he found that 100 per cent. were due to human bacilli; under five years of age, 16 per cent. were of bovine origin.

In cases from five to sixteen years of age, where the chief pathological changes were in the meninges, less than 10 per cent. were of bovine origin; while under five years of age, 18 per cent. showed the bovine bacillus in pure culture. The majority of cases of meningeal disease therefore seems to be caused by tubercle bacilli that have left the evidence of their presence in the bronchial glands. In such,

the bacillus always seems to be of the human type. A minority of cases are apparently due to bacilli which have found their way into the intestine and have left their evidence in the mesenteric glands. Some of these are caused by bovine, others by human bacilli.

In cases where the tuberculous disease was chiefly manifested in the abdominal cavity, between the ages of five and sixteen years, 65 per cent., and under five years, 57 per cent. were due to the bovine bacillus. In children, therefore, almost 60 per cent. of abdominal tuberculosis was caused by the bovine bacillus.

In tuberculous cervical glands removed at operation Cobbett found: over sixteen years of age, 10 per cent.; from five to sixteen years of age, 54 per cent.; while under five years of age, 80 per cent. were due to the bovine bacillus.

The high figures in the last two classes are due, in large part, to the results published by Frazer from Edinburgh, Scotland. As the accuracy of these figures has been questioned, Cobbett estimates that probably 50 per cent. of the cases of tuberculosis of the cervical glands at all ages is of bovine origin, while 75 per cent. is probably not too high a figure for children under five years of age. For the sake of completeness we may add that, in most countries, bone and joint tuberculosis appear to be due largely to tubercle bacilli of the human type, while lupus apparently shows many instances of infection by the bovine type.

To sum up we find that the great majority of cases of fatal tuberculous disease of the lungs and bronchial glands in children and adults seems to be due to the human type of bacillus. Tuberculous meningitis and general tuberculosis in children under five years of age show a considerable proportion of cases due to the bovine strain, while tuberculosis of the abdominal cavity and cervical glands show a high percentage of infection with the bovine bacillus. With the exception of tuberculosis of the cervical glands, no evidence has been adduced to show that bovine bacilli play any but the most subordinate rôle in the production of tuberculosis in the adult. In a personal communication from Dr. Mazyck P. Ravenel, he states that " as far as my records go, there are only some fifteen recorded cases of adult infection by the bovine bacillus," and that he has never been able to find a case himself except those of skin infection reported in 1902 in the University of Pennsylvania Medical Bulletin.

In estimating the total percentage of deaths from tuberculosis of bovine origin, Cobbett assumes that fatal infections in adults and older children are, statistically speaking, almost negligible, since the great majority of such deaths occur under five years of age. Taking the figures just given, and the figures for mortality due to various types of the disease at different age periods, he calculates that the proportion of deaths from tuberculosis of all kinds in children under five years of age, which are caused by the bovine bacillus, is approximately 5 per cent.; and that possibly 6 per cent. of fatalities at all ages are bovine in origin.

CHILDHOOD INFECTION

In 1903 von Behring, at Cassel, advanced the theory that tuberculous infection always occurs during infancy and, as a rule, remains latent until the bodily powers of resistance are lowered either at puberty, parturition, lactation, or as a result of malnutrition, overexertion or acute infectious disorders. In this conception, the bovine bacillus must play an important rôle. Of recent years the theory has been broadened to include the period of childhood, and one hears constantly the statement that nearly all tuberculosis in adults originates from infection during childhood and that adults themselves are practically immune to infection or to reinfection. The literature on the subject of the childhood infection theory is so voluminous that it is possible barely to indicate its general trend.

AGE INCIDENCE OF FATAL TUBERCULOSIS

In England, among five hundred consecutive autopsies on tuberculous children, the highest rate (more than 25 per cent.) occurred, according to Still, between one and two years of age, to fall rapidly to a relatively inconsiderable number after the sixth year. Other figures from German and English authorities fail to show such a marked decline after the sixth year.

My own clinical impression certainly corroborates the view that fatal tuberculosis occurs much more frequently under seven years than over that age—in the period up to puberty.

The most extensive figures are those of Cornet. He draws attention to the unreliability of percentages based upon the proportion of tuberculous deaths to total deaths—since the latter may vary so

largely from year to year owing to epidemic or other causes. Rather should percentages be based upon the number of deaths per 10,000 of those living at different age periods. Cornet's table, so constructed, depicts an average death rate from tuberculosis over a period of sixteen years in a population of 27,000,000 people. The total shows a gradual fall, from 25 per 10,000 during the first year to five per 10,000 during the fifth to the tenth year; a rise to seven per 10,000 from the tenth to the fifteenth year and thereafter a steady rise to 85 per 10,000 from the sixtieth to the seventieth year. In the Registration area of the United States, from 1910–1913, the mortality from tuberculosis per 10,000 living at the given age shows figures which, in the main, are similar except that the highest percentage occurs in the age period from 30 to 40 years of age. The significance of these figures, as they apply to our problem, lies in the gradual but steady increase in the percentage of deaths from tuberculosis beginning with the tenth to the fifteenth year period; with a preceding decline from the fifth year down to the tenth to the fifteenth year period. *A priori,* it requires considerable assurance to accept childhood infection as the sole explanation for the numerous deaths as late as sixty to seventy years of age.

On the basis of pathologic evidence therefore it is fair to conclude that the curve of mortality in tuberculosis shows a high point shortly after infancy, between 2 and 4 years—a low point in later childhood between 10 and 15 years and a general rise thereafter with the highest point, between 30 and 40—or later.

TUBERCULOUS INFECTION

The majority of tuberculous infections do not cause an immediate fatal illness—a fact which really owes its recognition less to clinical observation than to a laboratory method, the tuberculin reaction. As will be shown later, a definite reaction to tuberculin is generally accepted as a proof of a tuberculous focus, quiescent or active, somewhere in the body. In passing, however, it should be noted that the reverse is by no means always true. To present but a fraction of the available statistics; among 195 new born infants, Faludi failed to find any positive tuberculin reactions and Speck, in 159 infants under three months of age also had similar results.

Excluding cases of clinical tuberculosis, which, as a rule, prove to be fatal, we find the following:

Veeder and Johnston obtained a percentage of 1.5 positive von Pirquet reactions under one year of age; 5.5 per cent. from one to two years of age; 19 per cent. from two to four years of age and thereafter a steady rise to 38 per cent. from twelve to fourteen years of age.

Hamburger and Monti found a similar increase but a much more rapid rise, reaching 94 per cent. of positive results at twelve to fourteen years of age. Von Pirquet himself found 70 per cent. positive from ten to fourteen years of age. Ganghofer obtained 80 per cent. of positive results at thirteen to fourteen years of age.

The figures for the Children's Hospital, Philadelphia, in 1219 patients of all types, show a higher percentage of positive reactions under one year, *viz.,* 15 per cent., probably because only these infants who are suffering from marked malnutrition are subjected to the test; from one to eight years the percentage gradually rises to 42.0 per cent. at the latter age; from eight to ten years, 52 patients showed 32.6 per cent. positive reactions; from ten to twelve, 29 patients showed 31 per cent., while five patients over twelve showed 80 per cent. Apparently the percentage of infection is higher in Austria and Germany than in this country.

All of these figures for the tuberculin test show, therefore, a definite rise in the number of infected individuals from birth to puberty. They represent a hospital population or dispensary clientele however, which as Naegle and others have shown, gives almost 100 per cent. of infections after thirty years of age. Even allowing for this, Krauss estimates that at least 70 per cent. of all children at fourteen years have been infected with tuberculosis.

PERCENTAGE OF DEATHS DUE TO TUBERCULOSIS IN CHILDHOOD

Many figures are available to aid us in estimating the percentage of deaths from tuberculosis in childhood in so far as hospital statistics are concerned. For example, Shennan, at the Royal Edinburgh Infirmary for sick children, found at 1085 autopsies that the cause of death was due to tuberculosis in 38 per cent. In this country the percentage is smaller, but 20 per cent. is probably not too high a figure after the first year of life. According to the theory of childhood

infection, if only one-fifth of all deaths at this period are due to tuberculosis, while from three-fifths to four-fifths of all children are infected, the majority of the latter will carry their infection into adolescence or adult life when various factors will cause a recrudescence as mentioned in connection with Von Behring's theory. Most of the adherents of the childhood infection theory also believe that the first implantation of tubercle bacilli protects against reinfection in the vast majority of cases—just as one attack of scarlet fever or mumps or whooping cough also protects against recurrence. On this basis practically all adults are immune, and our efforts, generally speaking, should be exerted to prevent infection in early life.

IMMUNITY

The modern theory of acquired immunity to tuberculosis is based upon the results of experimental inoculation in animals.

When a healthy guinea-pig is inoculated subcutaneously with a pure culture of tubercle bacilli, there appears in from 10 to 14 days a hard nodule at the site of the injection which soon breaks down, forming an open lesion which may spread but never heals; at the same time the regional lymphatic glands become swollen. Later, when the organisms have passed through the glands to the general circulation, multiple tubercles form in various parts of the body and the animal dies in from 6 to 12 weeks, depending upon the size of the original dose and the virulence of the strain. If the guinea pig be given a second small dose a week or more after the first, the point of inoculation becomes indurated after a few days with a purplish areola; after a few more days the indurated area becomes necrotic and sloughs out, leaving a flat superficial ulcer which usually heals quickly and permanently. The glands regional to the second injected area are not involved. It is usually impossible also to reinfect the tuberculous animal by feeding, inhalation or through the abraded skin. Other animals show the same resistance to reinoculation, unless the dose be massive.

It is believed, therefore, that mild tuberculous infections in childhood confer a certain amount of immunity against reinfection with the tubercle bacillus. On the other hand, a primary infection at any age, if massive or frequently repeated before immunity is established,

is apt to be severe. For example, Bang found that Jersey cows, imported into Denmark, often die of tuberculosis sooner than Danish cattle, and explains it on the fact that Jersey cattle are almost entirely free from tuberculosis, hence are more apt to present a violent form of the disease when they become infected.

E. Schloss does not admit that tuberculous infection in early life is a vaccination for adult life, because, were it so, the class of people in easy circumstances which is relatively free from infantile "scrofulosis" should furnish a larger contingent of tuberculous individuals in adult life which is far from being the case.

Hamburger finds great similarity in the clinical course of syphilis and tuberculosis. The primary infection (lesion) of the latter occurs in childhood and in the majority of cases, remains dormant. Secondary manifestations in glands, bones, joints, meninges, etc., may follow within a few years but usually not until after the tenth year do we meet the tertiary lesions of lungs, kidneys, pleura, etc.

Romer has formulated the theory that phthisis of adults really is a manifestation of immunity against the tuberculous infection which was acquired during childhood.

It would be impossible to present within reasonable limits all the evidence pro and con this modern theory, that adults are practically immune to reinfection, and that they contract their phthisis, if at all, from a preëxisting dormant lesion in their own bodies. An important factor would be the possibility of the lesions of childhood becoming absolutely healed and quiescent—which Hamburger considers improbable, in a strict sense.

On the other hand, Eastwood and F. Griffith studied at autopsy 150 children's bodies which presented a naked-eye proof of tuberculosis. Emulsions from the tuberculosis foci in sixteen of the cases failed to produce tuberculosis when injected into guinea-pigs, although in nine of the sixteen cases tubercle bacilli, of typical morphology, were seen in the sections. It is difficult to believe that such healed lesions can ever be reactivated or that they can confer a high degree of immunity.

Authentic instances of marital infection also are too numerous to be explained merely on the basis that they all represent recrudescences in those already infected. In one noteworthy case, cited by Weber, a tuberculous husband lost four wives in rapid succession

from tuberculosis—although all of the wives were immune from suspicion of prior infection or the opportunities for it. It is much easier to believe that these represent instances of reinfection or new infection rather than that they were recrudescences of former lesions. Quite recently Minnig presents much evidence pointing to the frequency of marital infection.

It is also to be remembered that a successful reinfection of tuberculous animals can be brought about by massive doses. Calmette's experiments with immunization by ingestion are of interest in this connection. In cattle, by means of a single ingestion of virulent bacilli, he was usually able to produce an infection so slight that the animals became capable of resisting for more than a year repeated doses of bacilli which certainly infected control animals. The animals "vaccinated" by ingestion continued for about three months to harbor living virulent bacilli in their mesenteric glands, although they were no longer found after four to six months. Intravenous inoculation of large doses of virulent bacilli at this time produced no symptoms whatever, although control unvaccinated animals developed a rapidly fatal generalized tuberculosis. After a few more months, however, some of the vaccinated animals suddenly lost their immunity and developed disseminated lesions while the rest were found to harbor virulent bacilli in the internal glands. This clearly indicates that immunity may follow a primary infection, but also that this immunity cannot protect against reinfection indefinitely.

From the careful study at autopsy of fifty adults and ninety-three children, Opie found evidence of tuberculous infection in the lungs of all of the adults and twenty-two of the children (up to eighteen years of age). In only three of the adults was death due to tuberculosis, and in all of the twenty-two children. His conclusions are as follows:

Tuberculous pulmonary lesions of adults who have died of diseases other than tuberculosis are of two types: (1) Apical tuberculosis similar to the usual type of fatal phthisis and unaccompanied by caseation of the regional lymph-glands and (2) focal tuberculosis which may be found in any part of the lung and which is accompanied by caseation (or calcification) of the adjacent lymph-nodes. Focal pulmonary tuberculosis of adults is identical with the

tuberculosis of childhood, and occurs in at least 92 per cent. of all adults.

Tuberculosis of children does not select the apices, is accompanied by massive tuberculosis of regional lymph-nodes and exhibits the characteristics of tuberculosis in a freshly-infected animal, whereas the apical tuberculosis of adults has the characteristics of a second infection. Almost all human beings are spontaneously " vaccinated " with tuberculosis before they reach adult life.

In a further study of the same material, Opie found a marked tendency for apical lesions in the lungs of individuals previously infected, to pursue a chronic course and to become encapsulated, whereas the evidence showed that apical lesions in those who have not been infected previously tend to assume an unusually severe character. This corresponds to the results which follow the experimental primary and secondary inoculation of animals.

Opie further believes that the indications point to the conclusion that apical tuberculosis of adults is not the result of infantile tuberculosis but is caused by subsequent infection.

We know, of course, that there is nothing inherent to age itself which protects the adult—witness the terrific ravages of tuberculosis among adults of tribes or races when they are first exposed to infection. While we may accept without question the dictum that childhood infection accounts for a large percentage of tuberculosis at any age, it would seem that the teachings of the childhood theorists are apt to lull us into a false sense of security with regard to the possibility of adult infection or reinfection.

BOVINE TYPES OF INFECTION

The fate of the bovine bacillus in the child's body offers interesting grounds for conjecture. We have seen that infection with bovine strains is not rare in fatal cases of abdominal tuberculosis; that it has been found in 6 per cent. of cases of pulmonary tuberculosis, while it is quite common in the least fatal form of tuberculosis—that of the cervical glands. If these facts be true for fatal tuberculosis, they must at least be as true of cases which do not die, for there is every reason to believe that the human body is more resistant to infection from the bovine than from the human type of bacillus. These " bovine " infected children, therefore, must furnish a considerable pro-

portion of the positive tuberculin reactions, since the specificity of tuberculin in all probability embraces both types of infection. What becomes of this non-fatal positively reacting bovine type of infection during childhood?

There is no definite evidence that the bovine bacillus ever changes its essential characteristics by sojourn in the human body—at least during an ordinary lifetime. On the other hand, we have seen that the bovine bacillus is rarely found in the tuberculous lesions of adults, except those of the cervical glands. The only possible explanation would be that many of the bovine bacillus infections in childhood become completely healed and that the bacilli perish so that they can no longer be recognized as such. If this individual in later life succumbs to a tuberculous infection with the human type of bacillus, such infection certainly may be assumed to have occurred subsequent to his bovine infection, although the latter may have stamped him as tuberculous in childhood. Such an assumption cannot be disproved until evidence is afforded that the preëxisting bovine infection furnished an immunity equal to that from the human bacillus. It would seem, therefore, that a childhood infection with the bovine bacillus accounts for a considerable percentage of the positive tuberculin reactions in late childhood; that this fact would explain in part the relatively small percentage of fatal tuberculosis in childhood compared with the percentage of positive reactions; and that it further increases the probability that infections with the human bacillus can be acquired after childhood.

CONTAGIOUSNESS OF TUBERCULOSIS

The belief in the contagiousness of tuberculosis is not a creation of modern science, but in reality should be considered the foster parent of bacteriology, since to it the latter really owes its growth. Even in the beginning of the eighteenth century in Spain phthisis was made a notifiable disease, and in 1765 the custom in Italy was to burn the bedding of a consumptive. In the nineteenth century a reaction occurred and increasing importance was attached to diathesis.

In a consideration of the contagiousness of tuberculosis we must have definite facts clearly in mind lest we overemphasize or underestimate. These facts may be reviewed briefly with regard to (1) The existence of the tubercle bacillus outside of the human body, (2) Methods of dissemination, (3) Modes of infection.

VIABILITY OF THE TUBERCLE BACILLUS OUTSIDE OF THE HUMAN BODY

When the tubercle bacilli leave the original host their viability depends upon definite conditions. Direct sunlight may kill them within thirty minutes if they are spread in thin layers so as to be freely exposed. Even diffuse light will kill after several days. Upon these two basic facts depends possibly the existence of the human race. Moist heat at 90° C. for two minutes usually is fatal. In sputum a longer exposure to heat is necessary, owing to the protection afforded by the mucus, but boiling for five minutes is absolutely lethal. Milk also seems to protect the bacilli, and a temperature of from 65° to 70° C. for thirty or forty minutes, or boiling for three minutes is required to destroy them. The pasteurization or boiling should be done in closed vessels in order to secure an equal temperature in both the upper and lower layers.

After burial in the ground the virulence of the bacilli has been found to persist for from twenty-three to one hundred and sixty-seven days; and dried sputum, not exposed to light, does not lose its virulence usually for three months; rarely for so long as from six to eight months. Narrow alleys and courts and dark dwellings, therefore, undoubtedly favor the prolongation of the life of tubercle bacilli.

Putrefaction from the activity of other organisms rapidly diminishes and finally destroys the virulence of tubercle bacilli.

Chemical germicides are relatively less reliable than heat or sunlight, since even a 5 per cent. carbolic solution thoroughly mixed in equal parts with sputum requires from twenty to twenty-four hours to be effective. Practically, therefore, it is unsafe to rely on germicides at all. Boiling or burning should be the only means used for destroying the organisms on utensils, in sputum, etc.

METHODS OF DISSEMINATION

The sputum of the consumptive is by far the most important means for the dissemination of tubercle bacilli. By this should be understood not only the material coughed directely from the lungs and bronchi but also the mouth secretions, especially in children.

Young children usually swallow the products of their cough, but in its passage from the trachea to œsophagus the naso-pharynx and tonsils and subsequently the mouth may become infected.

Secretions from tuberculous lesions in the upper air passages or ears may contain bacilli, as does the pus from suppurating glands. In the latter, however, the bacilli usually are few in number—often of low virulence—and the danger from such a source lies more in the possibility that the tonsils and teeth, the original avenues of infection, may still harbor bacilli. The child with tuberculous glands, whether open or closed, thus may be a source of infection to others. Open tuberculous skin lesions and discharging bone sinuses, while not devoid of danger, are much less apt to cause infection than are the sputum and nose and mouth secretions.

The fæces and urine in cases of genito-urinary or intestinal tuberculosis contain numerous organisms, but the usual methods for their disposal practically obviate the danger of infection from this source.

Unless the mammary gland be actually diseased there is little evidence to show that tubercle bacilli can be transmitted in mother's milk. In 450 microscopic specimens of human milk from twenty-eight carefully-examined cases—from fifteen of which the milk was also injected into guinea-pigs—Wang and Cooley found an acid-fast bacillus only once, while none of the pigs showed any infection. A possible exception may also exist in the case of a generalized hæmatogenous infection of the mother before the bacilli have been able to produce lesions.

On account of the destructive action of light upon the bacilli while the drying process is taking place, street dust *per se* probably is not highly contaminated with virulent organisms. Contamination of the hands of children with fresh sputum which has been deposited on pavements and streets, Krauss considers to be one of the most important sources of infection.

The danger of the floor dust in a house where careless consumptives live probably cannot be overemphasized. It affords a constant menace to the infant or child who is continually putting its fingers or various objects into the mouth. It has also been repeatedly proven that the germ content of the air of a room is greatly increased by sweeping and dusting. Cornet estimated that probably more bacteria are inhaled in one hour in a room which is undergoing cleaning than in the remaining twenty-three hours after the cleaning is completed. He has also proved that animals may be infected experimentally in direct proportion to the distance they are suspended from an infected floor.

Eating Utensils.—In a recent article Colonel Cumming attempts to inculpate the spoon as one of the chief factors in the transmission of tubercle bacilli from sick to well. In his experiment, using guinea-pig inoculations, he found 35 per cent. of successful transmissions from the water in which contaminated spoons were washed and 25 per cent. from the rinse water used after washing. If the army technic for washing were used, we might not wonder at the result. Since the washing of two spoons was done with only 150 c.c. of water and the rinsing in only 50 c.c. of water, it is questionable whether the experiment can be said to offer a fair comparison with the dishwashing conditions that obtain with a much larger quantity of water in any average family. In 1909 J. W. Price clearly proved the protection which is afforded, even in a sanitorium, by the ordinary washing and rinsing of eating utensils. Certainly there will be many dangers of infection besides these, in any untidy, dirty household.

Flies.—That flies can become contaminated and contain tubercle bacilli in their dejecta has been demonstrated by André, but in view of the small amount of the infected material this source can hardly be considered of great importance. On account of the admixture of the bacilli in the tenacious mucus of sputum, it is also probable that the transference of the bacilli on the feet of flies is not as common an occurrence as may have been feared.

Domestic Animals.—It has been definitely proved that dogs can contract both human and bovine types of tuberculosis. The disease in dogs usually is of the " open " variety, often being pulmonary. Cutaneus ulcers may also occur which Petit finds are " incredibly " rich in bacilli. Instances of tuberculosis in the house dogs of consumptive individuals are by no means uncommon. The cat, on the other hand, appears to be susceptible only to the bovine variety of the bacillus. Parrots suffer from human tuberculosis, but canaries are rarely infected. The domestic pet, therefore, is not above suspicion. It must form numerically an unimportant source of infection for human beings, but the possibility may be considered in attempting to trace a source of infection.

MODES OF INFECTION

Congenital Infection.—Baumgarten was the first seriously to advocate the theory that many cases of tuberculosis are congenital

in origin, believing in the possibility that the bacilli can be transmitted and remain inactive and undiscovered in the child's body for long periods of time. It is true that congenital infection can occur, generally when the placenta itself is diseased. The infant often is stillborn or dies soon after birth. Most authorities consider it of extremely rare occurrence and the low incidence of clinical and fatal cases of tuberculosis, and the rarity of pathologic changes in the first six months of life, make any other belief difficult. Schlossman states that he has never seen recovery from active tuberculosis in infancy— and yet he is of the belief that hereditary tuberculosis probably is by no means rare. Until further research has been done the importance of congenital infection cannot be definitely settled, but the weight of present evidence is decidedly against it.

Inhalation.—Cornet was the most impressive advocate of the inhalation theory, basing his belief on the undoubted fact that pulmonary lesions outweigh all others in frequency and importance. He taught that, for inhalation to be successful, so that the organisms could be drawn deeply into the lungs, the sputum or other infected material must become completely dried and pulverized. Cornet recognized that during the drying process the bacilli would probably be rendered inert or killed by light or sunlight out of doors; he believed, therefore, that house infection by inhalation through the nose or mouth, especially the latter, in close proximity to the actively consumptive individual, is by far the most important factor in causing infection.

Flügge was the original sponsor for the theory of droplet infection by the moist particles which are ejected during coughing, sneezing or talking.

Mouth Infection.—Volland, I believe, was the first to insist upon the importance of mouth infection, acquired from various articles and from dirt which have been contaminated by sputum and which, in one or more of many ways, are introduced into the mouth. Krauss, in this country, draws a very strong and convincing picture of the frequency of this mode of infection during childhood.

Alimentary Infection.—The theory that infection by tuberculosis probably always occurs through the alimentary tract and that from this point through the lymphatic system infection is distributed to

various parts of the body, was one of Von Behring's most noteworthy contributions to medical thought.

Other Avenues of Infection.—While infection with tubercle bacilli can occur through wounds or abrasions of the skin—and even experimentally through the intact skin—for all practical purposes entrance through the mouth or nose alone need be considered.

IMPORTANCE OF THE DIFFERENT AVENUES OF INFECTION

Concerning the relative importance of these various avenues of infection, the discussion has been endless, nor can it be said that any definite decision has been reached.

Until recent years the most common method was presumed to be by inhalation, because in the vast majority of cases the lungs show the most extensive and oldest pathologic lesions. The possibility of infection by inhalation can be proved experimentally by causing animals to inhale soot-laden air and experimental evidence also shows that it is much easier to infect animals in this way than by feeding. For example, Gebhard found that 800 bacilli inhaled sufficed to infect a guinea-pig while ten to thirty million sometimes failed to do so when swallowed. Weber and Titze found that at least 10 milligrams of bacilli were required to infect a calf by feeding while 1/100 of a milligram would cause infection by inhalation. Practically the same results were obtained with dogs and goats. The evidence thus presented against alimentary infection is very suggestive. We must not accept the positive evidence of inhalation infection so readily, however, merely on the basis of experiments in which pure cultures of bacilli are deliberately sprayed within easy access of the inspiratory air current. Such opportunities, or rather dangers, rarely if ever obtain under actual living conditions. There can be no question, however, that dust, and with it germs, can be inhaled into the lungs either through the mouth or, with greater difficulty, through the nose.

Recently Corper and Enright have obtained very suggestive evidence that a certain small percentage of organisms (*B. prodigiosus*) instilled into the lachrymal sac, find their way into the naso-pharynx and, by inhalation, into the trachea.

The predilection of a majority of lesions for the right lung instead of the left have been proved in innumerable instances and the anatomical configuration of the bronchi, with the shorter and more direct

route, after bifurcation of the trachea, leading to the right lung, has been generally accepted as an explanation. In addition, the dividing spur formed at the bifurcation, lies to the left of the median line and foreign bodies are inhaled more frequently into the right than into the left bronchus.

Opponents of the inhalation theory of infection point to the fact that the ciliated type of epithelium is found as far down in the tree as the smaller bronchi and that the general current of secretions in the larger tubes is in the direction of the mouth. Inhalation, to be effective, therefore must carry the organisms deep, almost into the pulmonary alveoli. While the protective mechanism for ridding the bronchial tree of foreign invasion must be of vital importance, it certainly fails to prevent the numerous instances of bronchial and pulmonary infection of nontuberculous origin, and, *a priori,* cannot be expected to do better when the tubercle bacillus is concerned. Particularly must this be true when the individual is repeatedly exposed to large amounts of tuberculous-infected dust.

Still points out that the age incidence of clinical tuberculosis of the lungs in early life shows a striking analogy to the age incidence of bronchitis and pneumonia; 65 per cent. of his cases of acute bronchitis at the King's College Hospital occurred during the first three years of life, while Holt states that 80 per cent. of cases of primary bronchopneumonia occur in the first two years. After five years of age the incidence of both diseases falls off markedly. Still is inclined to interpret these well-recognized facts as indicating a special vulnerability of the respiratory tract in young children which would apply as well to tuberculosis as to other infections.

INGESTION

Since Klenke's first recorded cases of infection through the digestive tract, conclusive evidence has been presented that the tubercle bacillus can pass through the healthy intestinal mucosa, through the mesenteric glands and be recovered from the chyle in the thoracic duct. Access to the lungs through the right heart and pulmonary artery, therefore, would be so direct that the possibility of pulmonary lesions arising from intestinal infection is indubitable. The frequency of such infection, however, has been one of the most vigorously debated problems in the etiology of tuberculosis.

In a personal communication from Doctor Ravenel, a strong believer in the theory of intestinal infection, he emphasizes the directness of the route from intestines to lungs, with only the mesenteric glands intervening. He also cites the frequency with which the mesenteric glands are found tuberculous at autopsy; or, if not macroscopically diseased, yet large, soggy and crowded with tubercle bacilli. (Bartel and Spieler have also described a lymphoid stage of tuberculous infection of glands which can only be demonstrated by animal inoculation.)

Ravenel also quotes the classical experiments of Nocard to determine why blood serum spoiled when taken from horses during digestion. It showed that, during digestion of fats, many bacteria passed into the thoracic duct. Ravenel repeated the experiment, using tubercle bacilli in the emulsion, and had only two negative results, in both of which he had used nonvirulent cultures.

In experimental animals, therefore, there can be no doubt of the frequency of bacterial invasion through the mesenteric lymphatic system. If this be true of human beings to the same degree, the defensive mechanism possessed by the blood and glands must be amazingly potent, otherwise the lungs and their regional glands would show a much greater incidence of involvement in various pathological processes.

The opponents of the ingestion theory argue chiefly on the basis of the defensive mechanism of the glands themselves and on the known clinical facts of tuberculous disease. Cobbett cites Adami's views. Adami regards the lymphoid tissues of the intestinal mucosa as constituting the body's first line of defence against invading organisms while the glands draining the different areas are the second line of defence. The first is not spread in a continuous layer but is scattered, as in Peyer's patches, agminated follicles and the like. If the mucosa be intact, the individual in perfect health, and the dose small, it is probable that few tubercle bacilli penetrate the first line of defence. If the dose be enormous or if the mucosa be injured, the passage to the second line of defence is facilitated. That this passage of tubercle bacilli through the first line of defence can occur without causing any tuberculous lesions is generally admitted and probably occurs not infrequently in young children. It has also been demonstrated that organisms other than tubercle bacilli constantly

penetrate the mucosa in small number and are found in the mesenteric and bronchial glands. Not often do these organisms penetrate the second line of defence, however, and appear in the blood and internal organs. Cobbett, after a very thorough consideration of the evidence favoring the possibility of the tubercle bacilli thus penetrating the second line without leaving pathologic evidence is forced to the conclusion that only when large numbers of the tubercle bacilli are carried to the glands do the latter become permeable—and that when this occurs sufficient bacilli will have been retained in the glands themselves to cause disease there and thus to indicate the portal of infection. This has sometimes been called Cohnheim's law, and it seems as true to-day as when he enunciated it.

The evidence of infected or diseased mesenteric glands at autopsy in cases of pulmonary disease loses some of its value as proof of primary intestinal infection when we consider the relative proportion between diseased bronchial glands and diseased mesenteric glands. We find almost twice as many definite tuberculous lesions in the former as in the latter. Although it may be admitted that the lymphoid stage of tuberculous mesenteric adenitis would escape detection at an ordinary autopsy, it is inconceivable that infection passing through the mesenteric glands to lungs and bronchial glands would usually expend its final efforts in the chest and leave the mesenteric glands, histologically speaking, uninvolved.

Martha Wolstein suggests the theory that the lymphoid stage of tuberculosis described by Bartel and Spieler, may affect the mesenteric glands as a process secondary to infection from swallowed sputum from a tuberculous lung—and not as the evidence of the primary channel through which the infection of the lung took place. That children under five swallow all their sputum must be a practical factor of great importance if this secondary infection of the mesenteric glands actually occurs.

Against primary infection occurring in pulmonary tuberculosis by way of the intestines may also be cited the tendency for tubercle bacilli to lose their virulence or to be killed by the growth of other organisms. The diversified and active bacterial flora of the intestine might be expected to overgrow and destroy any but the more virulent, abundant or repeated tuberculous implantations.

The literature of the past twenty years abounds with instances

proving the extent to which milk is infected with tubercle bacilli and yet the proportion of children infected by such milk must be but a fraction of those who consumed it. Hess's studies for a period of three years of seventeen children who were known to have consumed infected milk, show that only one contracted tuberculosis in the form of cervical adenitis. This, of course, should not be construed as minimizing the danger from drinking tuberculous milk, but merely as emphasizing the comparative difficulty of infecting a human being in this way.

MOUTH INFECTION

The other avenue of infection, the mouth, partakes of factors belonging to both inhalation and ingestion. Volland's theory, however, is predicated both upon the frequency with which bacteria are introduced into the mouth and upon the fact that the oral mucosa, if damaged, and the tonsils, probably at all times, can absorb bacteria. Such infection would then proceed from the mucosa or the tonsils to the cervical lymphatics. It is undoubtedly true that tuberculous cervical adenitis is one of the most common forms of tuberculosis in childhood, and it has been believed that the infection passed down the cervical chain to the mediastinal and bronchial glands—subsequently in many cases to infect the lungs. Opponents of the theory, chiefly on pathologic grounds, argue that such infection logically should show a gradation from above downward with the more recent lesions in the mediastinum. As a matter of fact, however, such is not the case, for in the numerous instances where tuberculosis affects both the cervical and the mediastinal glands the gradation in the pathologic processes is from above downward and from below upward—the intermediate glands showing little if any involvement.

Krauss combats this pathological evidence on the ground of his experiments with guinea-pigs over long periods of time, using attenuated cultures of bacilli which caused localized non-fatal lesions. Krauss found that the disease often could be definitely followed from one set of glands to another and that the lesions would show at times great variations in their course, lingering and progressing at one point and at another healing and leaving no trace. If such results can be accepted as applicable to human infection, it can be seen at once that no reliance can be placed on the relative age of the pathologic lesions. It is also obvious that there may be a wide variance in

the rapidity with which lesions develop in organs of dissimilar structure while the factor of mixed infection must, at times, play an important rôle.

A more important objection to the theory of infection direct from cervical to mediastinal glands rests on anatomical grounds. The very thorough investigations of Most and Beitzke prove very conclusively that occasionally some of the median group of deep cervical lymphatics connect with the supraclavicular glands, but that there is no direct path between the cervical glands and those of the pleura or tracheo-bronchial system. Very exceptionally Most found an anomalous indirect connection between the left apex and two or three deep cervical glands.

From a practical consideration of the probable point of entry for the tubercle bacillus, however, it is clear that Volland's "smutz-infection" of the mouth must occur with great frequency.

The common practice of the mother or caretaker testing the bottle of milk by tasting it immediately before giving it to the baby will be attested by any pediatrician of experience—nor is the practice confined to the densely ignorant classes by any means.

Not one mother in a thousand, in spite of vigorous propaganda, can resist what Krauss calls the "kiss of instinct." Every child, both high and low, puts any convenient article into its mouth—subject only to the limitation of size, and not always strictly subject to that. It would require a regiment of caretakers to prevent it. Practically every child crawls on the floor, which, in spite of all the labors of the most orderly of housewives, is contaminated at times with fresh sputum from the city streets and pavements.

If we are to reject the theory of ingestion, therefore, in explaining in large part the frequency of pulmonary disease, we must find other paths from mouth to lung.

Krauss insists on the availability of the lymphatic route, through the cervical chain to the thoracic duct and thence to the right heart and pulmonary artery, without necessarily setting up recognizable disease in the glands.

Several factors militate against the acceptance of this theory. Tuberculous cervical adenitis is one of the most common forms of the clinical disease in childhood, but pulmonary tuberculosis comparatively is an infrequent accompaniment. Again, while it may

be admitted that the organisms may pass through glands without setting up disease, it certainly controverts one of the fundamental facts in experimental primary tuberculosis; namely, that a primary injection of tubercle bacilli is followed first by disease in the injected area and, secondly, in the regional lymphatics which drain that area. In childhood the liability of the lymphatic tissue to inflammatory reaction to any infection is too well marked to permit of readily accepting the theory that tubercle bacilli frequently pass the glands without leaving a demonstrable trace.

Another route from mouth to lungs is suggested by some experiments of Cobbett's with the *Bacillus prodigiosus*. This organism is not found in normal lungs or in air under average conditions. In ordinary inhalation experiments with the *Bacillus prodigiosus* he found that all parts of the lungs could be easily infected. After feeding experiments he also found that some of the bacteria had passed down the trachea instead of the œsophagus. That this was the mode of access to the lungs could be definitely inferred because the guinea pigs were killed soon after the feeding and sufficient time, therefore, was not allowed for the absorption of the *Bacillus prodigiosus* by the mesenteric lymphatics and its subsequent transfer to the mediastinal and pulmonary glands.

To meet the criticism that the bacilli in the mouth were drawn into the lungs in consequence of the convulsive inspirations during the death struggle, Cobbett constructed a clamp which could be made to occlude absolutely the trachea. After placing with a platinum loop, minute quantities of emulsified *Bacillus prodigiosus* into a guinea pig's mouth, the clamp would be tightened and simultaneously the animal killed by a blow on the head. Even with these precautions it was possible to recover the bacillus from the lungs. The only conclusion possible was that bacteria in the mouth were inhaled even during the few inspirations that were drawn before the clamp was tightened.

At first glance this appears to be almost preposterous, and yet certain factors which obtain chiefly in childhood may make it worthy of consideration. When we consider the forcible and sudden inspiration which succeeds the violent expiration of a cough or cry, or the conditions which obtain when running with the mouth open, constant occurrences in the life of a child, the possibility of " aspiration " of

mouth bacteria is not so remote. The chief objection to the theory rests in the infrequency of infection with other pathogenic bacteria of the mouth, compared with the opportunities for it. This, however, can be explained on the grounds of the " resistance " which normally exists toward such infections. Resistance to a primary infection with the tubercle bacillus is much less to be relied upon.

In this connection Cobbett's investigations in the bacterial content of normal organs are pertinent. Even in nose breathers, such as guinea pigs and rabbits, he has found that the lungs even in the marginal portions invariably yield copious cultures of bacteria, including moulds, streptothices, spore-bearing bacilli, sarcinæ and cocci. On the other hand, the other great organs, including the lungs of fœtal guinea pigs, are either sterile or yield, at most, an occasional and possibly accidental colony.

To sum up, we find that most authorities concede to inhalation the first place in introducing infection, while the relative importance of ingestion, or lymphogenous transmission from the mouth, remains to be defined.

INFLUENCE OF THE DOSE

Infection should also be viewed from another side—that of the amount—or, as Cobbett expresses it, "the influence of the dose." Experiments conducted in the laboratory of the Royal Commission in England show conclusively that small doses of virulent bovine bacilli produce, when injected into calves, only localized or limited lesions which soon become fibrous and calcareous and thus assume a retrogressive type; while the calves themselves, after a transient disturbance of health, remain in excellent condition until slaughtered. Medium doses produce irregular results, but large doses invariably cause generalized tuberculosis. A priori, we would not expect such a marked difference when we consider that the small dose, by multiplication in the body, can soon become large. The most probable explanation is that the time required for the small numbers of bacilli to proliferate allows opportunity for the mobilization and development of the protective forces of the body. The multiplying bacteria thus find themselves surrounded, not by normal vulnerable tissue, but by a special zone of a highly-resistant character. In very susceptible animals, such as the guinea pig, even the smallest dose is fatal, presumably because they are incapable of developing the appar-

atus of immunity fast enough to cope with the mutiplication of the tubercle bacilli. Arguing from experimental to natural phenomena, there seems to be no reason why the dose of infection may not play a comparable rôle; and the differences seen in resistance in certain species of animals probably also obtains in different human individuals and at different times in the life of the same individual.

When we analyze the facts with regard to the risks of infection, we find that during the first year the contacts developed by the baby are limited largely to the immediate family and its circle of friends and relatives. During this time the infant certainly has every opportunity to become infected if active viable tubercle bacilli are in the air or dust of the home, and it is difficult to see how infection can be avoided under conditions that obtain in the homes of the lower classes. As a matter of fact, it is possible to determine the source of infection in the home in a very large percentage of cases of tuberculosis in childhood. If the infant is not exposed to tuberculosis in its home, however, it is equally difficult to see how it can be infected by other than the bovine bacillus in its food.

Later, as the child begins his adventures out-of-doors, the opportunities for diverse and untraceable infections multiply enormously, so that the majority of city children acquire it by the time puberty is reached. All evidence goes to prove that most infections are due to intimate contact, chiefly indoors, direct or nearly direct, with another individual suffering with a like disease.

It would seem that this is the most feasible explanation for the remarkable phenomena presented by the mortality statistics and the increasing percentage of infection in childhood. Opportunities for massive infection in the homes undoubtedly must be more frequent during the first years of life, when the immature child is so dependent for help upon the adults or older children of the household and upon milk as a food.

As soon as he becomes independent and spends so much of his life out of the home, he avoids, perhaps, repeated massive infections but acquires opportunities for minute, more or less casual, infections, which produce minor, often unrecognizable, forms of disease. From these he recovers with immunity to reinfection—at least for considerable periods of time.

POPULAR FALLACIES IN THE PRACTICE OF PÆDIATRICS *

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WITH the advance in science and the changed attitude of the public concerning the child, the old superstitions are gradually disappearing, and a common sense attitude with a solid scientific basis is beginning to prevail.

The future of the race depends upon the child.

The welfare of the race does not depend upon medical treatment of sick children, but upon preventive measures.

The old adage " An ounce of prevention is worth a pound of cure " is only now being fully realized in its application to the child.

Preventive medicine is only possible with the intelligent coöperation of the public, and the public can only coöperate when it has an intelligent idea of what is expected of it.

The public must therefore be educated. Mothers and fathers must be taught the fundamentals underlying child welfare.

The physician should be the authority in every community on questions of public health. It is, therefore, absolutely necessary that every physician, no matter what specialty he practices, should have a good grasp on the fundamentals underlying motherhood and childhood.

The most fundamental part of every physician's practice is the care of mothers and children, and there is no part of his practice which will pay such high dividends in the future of the community and the nation, and if he does his work well there is no reason why the annual monetary dividend should be passed unpaid.

Any physician who neglects the best interests of the children entrusted to his care is not doing his best for his country.

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* An informal talk given before the physicians of Spokane and Portland, Oregon, March, 1920.

THE INFLUENCE OF TRADITION

There is no department in the whole field of medicine where tradition plays so big a rôle as in pædiatrics. Traditions which have been handed down for generations are difficult to displace. It is necessary to have a clear conception of a subject in our own minds before we can hope to convince others. It is not enough to say that a thing is wrong. Sound reasons must be advanced which will appeal to the common sense and judgment of the average individual.

Many of the fallacies which prevail in the public mind are still held by many of the doctors themselves, and of course by the nurses who receive their instructions directly from them.

It is with the idea of disabusing your mind of some of these fallacies which are still popular with a good portion of the medical profession that I shall talk to you a little while this evening.

We must cease to regard the child as a creature (at least physically), as being conceived by *divine decree,* and regard it as one of the animal species, obeying all the natural laws which they observe.

If a child is normal at birth, its future will depend largely upon the food and care it receives. We must, therefore, get rid of the fallacy that the career of the child only begins at birth. It begins at conception and during the entire period of gestation and even lactation is almost wholly dependent upon the mother. Prenatal care is, therefore, an absolute necessity in all cases.

The idea that a large percentage of deliveries require artificial interference is also fallacious. This is demonstrated in countries, such as France, where 90 per cent. of the women are delivered by midwives, without the use of instruments. We see many children permanently injured by forceps, and we cannot help feeling that an attitude of intelligent watchful waiting would have prevented many of these.

ERRONEOUS BY-PRODUCTS OF OBSTETRICS

The child must cease to be a by-product in the practice of obstetrics, and obstetricians must study pædiatrics as well as obstetrics.

That the stump of the cord requires treatment in the way of antiseptic dusting powder is fallacious. The cord will mummify and "fall-off" more quickly and with less danger of infection if allowed to remain in contact with the air and only protected by a thickness of sterile gauze.

That a baby must be bathed directly after birth is fallacious. Infants lose heat rapidly, and unless the warmth of the room and water are ideal, they will be found to have a sub-normal temperature which will be followed by coryza, bronchitis and not infrequently pneumonia, and is responsible for many deaths in feeble infants. The intense, diffuse redness of the skin, occurring after the first bath and frequently accompanied by miniature postules, is an acute dermatitis resulting from excessive friction in the attempt to remove the vernix caseosa during the bath. This condition is often exaggerated by the use of an improperly neutralized soap.

Another common fallacy, and one resulting in much harm to the infant, is that of swabbing the mouth of newborn infants. The gauze stretched over the index finger, with which the mouth is usually forcibly swabbed, removes the delicate epithelium from the mucous membrane. Wherever the epithelium is removed, a white spot of exudate appears. Swabbing the mouth of young infants is the most frequent cause of stomatitis. The secretions keep the mouth sufficiently clean until the teeth appear, when they should be brushed daily with a soft brush with some mild alkaline solution.

The too common belief still held by some of the medical profession, that there are many mothers who cannot nurse their babies, is fallacious. It has been recently demonstrated in the Breast Feeding Clinic at the University of Minnesota under the direction of Doctor Sedgwick that 95 per cent. of all mothers can nurse their babies in whole or in part, the requisites being proper technic—assuming, of course, that the hygienic conditions of the home are of average character. The conclusions usually drawn from an estimation of the fat content of a specimen of mother's milk is usually fallacious, since the first of the milk is low in fat while the last portion is usually extremely high. The percentage of fat varies from day to day. Most breast milk is good, and the disturbance of digestion is usually due to having " too much of a good thing."

FALLACY OF CONSTIPATION IN THE BREAST-FED

The belief that daily stools are necessary in a breast-fed baby is fallacious. Barring anatomical abnormalities, there is no such thing as constipation in a breast-fed baby, at least during the first weeks.

This statement is the result of the analysis of 300 consecutive cases born at the University of Minnesota Hospital, none of which had any cathartic, enema or suppository during their two weeks' stay in the hospital. The daily average number of stools in this series of cases was less than two daily, so that more frequent stools were usually regarded as due to overfeeding. The bowels will move when a sufficient residue has collected in the rectum to stimulate the normal reflexes.

The classical dose of castor oil on the third day is responsible for much of the digestive disturbances in infants. We found that the stools if examined microscopically usually contained blood after a dose of castor oil, and if the dose is frequently repeated, practically always do. *Castor oil has not the " soothing elements " it has generally been reputed to possess, but is a direct irritant to the intestinal mucous membrane, capable of little good and infinite harm.*

THE FETICH OF CIRCUMCISION AND PATHOLOGICAL TEETHING

The almost universal idea, even among physicians and nurses, that because the prepuce in male infants is adherent, the adhesions require to be broken up or circumcision performed, is absolutely fallacious. The prepuce of all male infants is adherent at birth, and if left alone a large percentage will become free and retract after a few months. There is a certain percentage of cases, however, and particularly where the prepuce is redundant and adherent around the meatus, where perhaps circumcision sometime within the first year would be beneficial. That Nature should have made such a blunder as to necessitate all foreskins being amputated, is incredible.

The still common belief, even among physicians, that " teething " is attended with such symptoms as fever, diarrhœa and convulsions, is fallacious and capable of much harm. The eruption of the teeth is a physiological process like the growth of the other organs, and when abnormal symptoms appear, the real cause of the symptoms must be sought, and generally will be found to be due to something other than teeth.

That the spasmodic attacks such as laryngeal stridor and convulsions, from which a small percentage of children suffer, are due to teething or worms, is also fallacious. The majority of these children

are born with a constitutional instability of the nervous system known as *spasmophilia*. Such infants will be found to have certain typical muscle reactions, and will react in a typical manner to the galvanic current. The crowing respiration occurs in this type of child. The onset of any of the infectious diseases, or for that matter any infection or an attack of indigestion will frequently be accompanied by a convulsion. The nervous irritability is always exaggerated in these cases by overfeeding, and especially by cow's milk. There is perhaps no constitutional abnormality in children where more can be accomplished by intelligent care and feeding than in this one.

I have rambled along at length and called your attention to a considerable number of the sins both of omission and commission of which we are all frequently guilty, and I could continue to mention many more, but time and your indulgence will not permit. I think I have said enough, however, to impress you with the gravity of the situation and the necessity of physicians generally informing themselves of the fundamental principles underlying child life and development.

REPORT OF A CLINIC AND WARD CLASS AT THE SAMARITAN HOSPITAL DISPENSARY OF PHILADELPHIA AS TAUGHT IN THE PÆDIATRIC DEPARTMENT OF THE MEDICAL SCHOOL OF TEMPLE UNIVERSITY

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BEFORE considering the cases to-day, it would be well to review the important subject of history taking in children. It differs somewhat from history taking in adults and you should familiarize yourselves with the details of this procedure as related to children.

After having noted the name, age, sex, color and address of the child, the first thing to do is to find out the chief complaint—the ailment for which it has been brought to you. It is best in obtaining this information, to let the mother talk in her own way, for she can usually tell you all the facts about the child's condition. Do not change any of her statements, but put them down as given to you. While she is speaking, watch the child continually, in order that you may observe any signs or symptoms that may be present, and also to get acquainted with the child itself.

The next thing is to inquire about the family history—whether the father and mother are living and well, and their ages—how many children there are in the family, their ages and state of health, and whether the mother has had any miscarriages. Then ask concerning the child's past history. Find out whether it was a full-term baby or prematurely delivered, whether born normally or with the aid of instruments, and whether breast-fed or bottle-fed. If the former, note the date of weaning; and if the latter, get the details of the formulæ given. Next ask the weight and height of the child at birth, and learn whether the teething period was normal and on time, and whether it was accompanied with convulsions.

Now find out whether any other illnesses have occurred since the

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child's birth. In order to learn this, it is best to enumerate to the mother the various diseases of infancy and childhood, for two reasons: first, to remind her of them; and, second, because many persons do not consider such common conditions as measles and tonsilitis, for instance, as diseases.

After this, make the physical examination. Under this head, put down the height and weight, temperature, respiration and pulse, and proceed with the examination. Why is it important to know the height and weight figures?

Ans.: To see whether the child is gaining or is standing still.

Dr. L.: How much should it gain in weight during the first six months?

Ans.: It should double its weight at birth.

Dr. L.: How much should it weigh at the end of the first year?

Ans.: It should have trebled its weight at birth.

Dr. L.: How much should it gain in the second year?

Ans.: It should gain about six pounds.

Dr. L.: It should nearly double its weight at one year by the age of five, and nearly treble it by the age of ten.

How should it gain in height?

Ans.: If the height at birth is about twenty inches, it should measure about twenty-eight inches at the end of the first year, and thirty-two inches at the end of the second year. It should then gain about three inches in height each year until the age of five, and about two inches a year after this until it is eleven years old.

Dr. L.: That is right; but, of course, these rules for height and weight vary in different races. It is important, however, to see that the height and weight bear the proper ratio to each other; because if the child is ten per cent. under weight for its height, it is considered to belong to the class of malnourished children.

The child should be examined absolutely naked, especially during the first examination; because you may in this way find signs and symptoms that you would not always discover with the clothes on. Observe the skin, and note whether the color is good and whether there are any roughnesses or other blemishes upon it. Note the condition of the hair. Look at the mouth and at the teeth, throat and nose. The first set of teeth, called the milk teeth, deciduous teeth, or primary set, numbers, in all, twenty. It is completely erupted between the ages

of two years and a half and three years. The second, or permanent set, contains thirty-two teeth, when complete. Its eruption begins at about the age of six years.

Examine the tonsils, and see whether there are any adenoids. It is best to carry an outfit to examine ears in children, as many ear drums rupture without temperature and without pain. Observe the kind of breathing, and note the facies.

Examine the heart and lungs, and notice the condition of the abdomen. See whether there is any umbilical or inguinal hernia. Observe the joints and bones, and watch for spinal curvatures. The genitalia, rectum and anus must not be overlooked. After this, you may proceed to make a diagnosis.

FIRST PATIENT (EPISTAXIS)

P. B., aged three years and nine months, female, white, living at —— Street, Philadelphia. The mother brought her to the clinic on account of a sore nose. She has difficulty in breathing, especially at night. The appetite is poor. The child complains about twice a week of nose bleed and pain in the epigastrium in the morning, before eating. There is no history of vomiting. The bowels and kidneys act regularly, the child having two bowel movements a day. Her sleep is sound but very noisy.

Family History.—The father, aged thirty-one years, is living and well, except for some injuries received during the war. The mother, twenty-nine, is also living and well. This is their only child.

Previous History.—The child was delivered normally, after a difficult labor, at full term. Her weight at birth was eight pounds and a half. She was breast-fed until the age of thirteen months. Teething was normal. The child had measles and then whooping-cough at the age of sixteen months. She had some sores on the skin last year, the condition having been diagnosed as eczema.

Physical Examination.—Weight, 35 pounds; height, 38½ inches. Temperature, 98.2°; pulse, 119; respirations, 28. General appearance, good. The child is well nourished, has a good musculature and a good color. Heart, rather slow but normal. Respirations harsh on the left side posteriorly, but this is usually normal in infants and young children. The skin is slightly rough, and there is an abundance of hair over the arms and lower part of the back. The

head is of normal size, measuring 19.5 inches; and the eyes appear to be normal. She has a placid facies and a good mentality. There are some excoriations on the cheeks and at the alæ nasi, with a purulent discharge from the nostrils, but none from the ears.

Nasal breathing is labored. She has to breathe with the mouth open. There are small, buried tonsils. The whole set of the twenty milk teeth are present, but some of them need attention. Heart and lungs, negative. The genitalia, rectum and anus are normal.

Now let us discuss this condition. What is apt to give you a history of bleeding at the nose?

Ans.: A nasal diphtheria.

Dr. L.: Yes, nasal diphtheria is one thing. What else?

Ans.: Congestion of the head is another.

Dr. L.: Yes. Anything else?

Ans.: Tonsils and adenoids.

Dr. L.: Tonsils and adenoids cause it but rarely. Picking of the nose will do it, however. An ordinary coryza may be present. Some vasomotor condition, influenza or the preëruptive stage of measles may produce a coryza; and when crusts are formed and picked, bleeding at the nose, or epistaxis, may be induced.

What, then, do you think is the cause in this case? Why would you exclude nasal diphtheria? You often get a history of exposure to diphtheria in such cases.

Ans.: If she had that, she would be very sick.

Dr. L.: Yes, she would suffer from depression. There would be excoriations, and you would see a serum-like discharge or a membrane appearing at the nostrils. There would be a temperature, and you would also have the bacteriological findings to rely on.

Now, how would you exclude the preëruptive stage of measles?

Ans.: She has no photophobia, no lacrimation, no temperature, and no Koplik's spots.

Dr. L.: Right. How would you exclude influenza?

Ans.: If she had that, she would complain of aches and pains in the body, headache and fever.

Dr. L.: Well, what is the diagnosis in this case, then? Why should this child be bleeding from the nose, with no temperature or anything else to account for it?

Ans.: It must be a local condition. There is a rhinitis present.

Dr. L.: Is the discharge of rhinitis usually acid or alkaline?

Ans.: It is acid.

Dr. L.: Yes, that is why we use alkaline irrigations for the nose in that condition. There is also an excoriation. The child probably began to pick her nose on account of the rhinitis, and kept it up until she ruptured some small blood-vessels. The result was that she had epistaxis. Until two or three weeks ago she was in a healthy condition. Therefore, this is a case of epistaxis due to ordinary coryza, probably just a cold, aggravated by traumatism from picking.

Now what treatment shall we give for this condition?

Ans.: An alkaline wash for the nose.

Dr. L.: What else?

Ans.: A bland oil.

Dr. L.: Yes. Anything else?

Ans.: A tonic.

Dr. L.: She does not need a tonic, but she does need something to help elimination. Her mother should see that the child's bowels are moving regularly, and should be careful to restrain her from picking the nose. That is the most important thing. I will give her an alkaline spray, to soften the crusts. This should be followed by three drops of the following mixture, instilled into each nostril three times a day: Camphor, one grain; menthol, one grain; and liquid alboline, one ounce; and we refer her to the nose and throat department.

SECOND PATIENT

E. H., white, female, six years of age, was taken sick about three months ago with headache, loss of appetite and epistaxis. She also complained of some pain throughout her body, and developed a fever. These symptoms have been present all along in a mild degree.

Her family history is negative. All are well at home.

She was born normally at full term, and was raised on the breast. Except for an attack of measles, and one of chicken-pox about three years ago, she has been pretty healthy until two or three months ago.

Physical Examination.—Temperature by mouth, 99°; pulse, 110; respiration, 24. Weight, 41¼ pounds. Height, 43½ inches. General appearance, fair. Nutrition, grade 2. Facies, placid; head, well shaped; color, somewhat pale. The muscular development is rather poor. The ears and nose are negative, except for some dry scabs in

the nostrils. The mouth shows no congestion, but there are small buried tonsils, and a full set of twenty teeth are present, and in good condition. There are palpable cervical glands. The eyes seem normal. The chest is fairly well developed. The heart and lungs are negative. The abdomen is slightly distended and tympanitic. The genitalia appear normal. The bones and joints are negative. There is a slight lateral curvature of the spine. The anus and rectum seem normal.

What diagnosis would you make from such a history?

Ans.: High blood-pressure.

Dr. L.: What makes you think of that?

Ans.: The headaches.

Dr. L.: High blood-pressure is not common in children, but is found more commonly in adults with arteriosclerosis. What would you say, Doctor?

Ans.: I did not hear all of the history. Were there any chills?

Dr. L.: No.

Dr. D.: Did she have a running nose?

Dr. L.: Yes.

Dr. D.: Lacrimation?

Dr. L.: No.

Dr. D.: It was probably a kidney condition.

Dr. L.: That sounds very indefinite. Name some kidney conditions.

Dr. D.: Acute congestion of the kidneys; acute diffuse nephritis (also called acute exudative nephritis); chronic productive nephritis; chronic interstitial (or chronic diffuse) nephritis; suppurative nephritis (or abscess of the kidneys); tuberculosis of the kidneys; renal calculus (or gravel); and perinephritis, or perinephritic abscess.

Dr. L.: While this classification covers the most common conditions of the kidney, it may be disappointing to know that there are no grounds in this child's history for the least suspicion of any such kidney conditions as you mention.

The next doctor: What do you think?

Ans.: Ordinary cold, grippe, or influenza.

Dr. L.: That is exactly the statement that I have been waiting for. You men must not forget this so-called influenza, especially since

we had such appalling fatalities during the epidemic that occurred nearly two years ago.

The exciting cause of true influenza is the small, non-motile bacillus of Pfeiffer, which is found in the sputum, blood and spinal fluid. It was found by some in the early cases of the so-called influenza epidemic last year; but in this present epidemic, there have been no Pfeiffer's bacilli present, although various microörganisms have been found, such as the Micrococcus catarrhalis, the staphylococcus, the Streptococcus hæmolyticus, the pneumococcus, the Bacillus mucosus capsulatus, and many others. It is claimed by some that no single organism is responsible for this condition, which may be termed false influenza, or grippe. It is merely a syndrome of symptoms typical of influenza, due to various microörganisms, and sometimes mistakenly called influenza. Doctor Park, of New York, took cultures from each of six members of one family, who were all sick with the so-called influenza, and inoculated the material into six guinea-pigs at different times; and at no time did he find an organism that was the same in the whole six, or that was the only one present. While others believe this epidemic to be a modified influenza in which Pfeiffer's bacillus is found early, but is subsequently overshadowed by the swarming number of other microörganisms, especially streptococci.

Abroad, Vincent's spirillum was found present in the malignant types of influenza. At the Navy Yard in Philadelphia, researches were made in the bad cases, with the result that Vincent's spirillum was also found in them. What do these organisms cause?

Ans.: Vincent's angina.

Dr. L.: What are the symptoms of that condition?

Ans.: Swelling and much soreness of the throat, an offensive odor, pseudo-membranes over the tonsils, and rise of temperature.

Dr. L.: The typical symptoms of Vincent's angina were not present in these cases, but the organisms were there. The treatment given consisted in injections of salvarsan and neosalvarsan; and wonderful results were claimed to have been secured. These organisms, however, cannot be considered as the cause of grippe. We still do not know the specific or definite bacterial etiology of this present epidemic.

We have now considered the exciting causes. What other kind of causes is there?

Ans.: Predisposing causes.

Dr. L.: What are they?

Ans.: Atmosphere, or climate, sex, race, and social condition.

Dr. L.: While these may be some of them, they certainly play no part in the etiology of this condition. Neither is the previous history or the age of much importance. One can be young or old, can reside here or elsewhere, can belong to one race or the other, and yet one will not be immune from becoming a victim to the epidemic. The condition has been found in the new-born and in all stages of childhood, just as it is found in adult life. Lowered resistance, exposure to wet, unhygienic surroundings, undernourishment, and certain physical defects, however, are true predisposing causes—exposure to the infection being the exciting cause.

The direct contagion is through the air, and the entrance to the system is through the respiratory tract. The pathology of the disease is chiefly catarrhal. It usually commences with a respiratory catarrh. The patient gets a nasal discharge; photophobia, lacrimation and acute bronchitis follow; and he may also have a catarrhal condition throughout the alimentary tract.

The patient may have the typical or the modified form of the disease. In the first, the symptoms are those described in the textbooks, while those in the modified form are a little different.

What is the incubation period in influenza?

Ans.: Twenty-four to forty-eight hours.

Dr. L.: From one to three days. It is a rather short incubation. What are the symptoms during the incubation period?

Ans.: Malaise, irritability, headache, vague pains and lack of appetite.

Dr. L.: Is the onset sudden?

Ans.: Yes, it is sudden.

Dr. L.: What are symptoms of the attack? The symptoms, of course, vary with the form—whether it is respiratory, gastro-intestinal, nervous or cardiac; also according to the degree of severity, and according to whether it is a typical or modified attack. Describe the typical form.

Ans.: The patient suddenly becomes very ill. There is usually high fever and chilliness.

Dr. L.: Sometimes, instead of chills, there are convulsions in

children; because these, in the child, take the place of chills in the adult. Then, if the child is old enough, it will complain of pains in the limbs, back and head; while in younger children their discomfort is evidenced by their actions or state. There is running at the nose in many cases. The temperature does not usually remain very high, but pursues an extremely irregular course. I found many typhoid types of temperature in these cases. Some patients had high temperatures at night, with remissions to normal in the morning, while others had high fever in the morning and low at night, with increased respirations and increased heart-rate. How and when does the temperature go back to normal?

Ans.: The temperature comes down by either lysis or crisis, within three or four days after the beginning of the attack.

Dr. L.: That is right. Often vomiting and diarrhœa develop, and the anoræxia is marked. Prostration is also very marked, and this is characteristic of the disease. The engorgement of the mucous membranes of the nose and throat, often setting up a trachitis or bronchitis, is commonly present. The various groups of symptoms characteristic of the different varieties are present, in addition to those just mentioned.

Of course, the child that we are dealing with now is an example of a convalescent from the type of cases that we have had in the frequent epidemics. In the adults, you commonly see the mulberry lips, the putty face, the asthenia and the hæmolytic sputum in the severe attacks. These are not common in children; and, as they usually swallow the sputum, the stools may show large clots—melenic stools. This year, we did not see so many cases of epistaxis as we did in 1918. They were very common then, but not so common in children as in adults. The throat is usually quite sore; and if the inflammation spreads, there is œdema with the sore throat.

While it is true that the termination may be by either lysis or crisis, you must remember that pneumonia is a frequent complication of this disease and may be associated with a false crisis. Whenever a pseudo-crisis occurs in pneumonia, you should be on guard, for it is a dangerous sign. It usually means that a new area of involvement has occurred before the original lesion is resolved. This produces a more toxic condition, and that is the cause of the fatalities. In the last epidemic there were about one hundred and fifty thousand

cases in Philadelphia, with about twelve thousand six hundred deaths.

The complications of influenza in children are very numerous. I have already referred to the most important and most fatal of these complications, pneumonia. What form of pneumonia commonly follows influenza?

Ans.: Bronchopneumonia.

Dr. L.: What other form do you know of?

Ans.: Lobar pneumonia.

Dr. L.: How would you differentiate between the two forms of the disease?

Ans.: The lobar is primary.

Dr. L.: It is usually so, but not always. There were quite a few croupous pneumonias among these cases. A bronchopneumonia, however, is commonly secondary.

In bronchopneumonia, all the symptoms are irregular. We have irregular temperature and irregular pulse—in fact, irregular everything.

The four steps in making a physical examination must be remembered and carried out with every patient you examine, especially a child. You must do this while you are a student, when you become a resident physician, when you become a general practitioner, and when you take up a specialty, for they are very important. The first is inspection; the second, palpation; the third, percussion, and the fourth, auscultation.

You must get into the habit of observation, especially with children; for you cannot talk to them as you can to adults. On inspection, what do you find in these two different forms of pneumonia?

Ans.: You find rapid, shallow breathing.

Dr. L.: Yes, you find that; and you find the typical facies. " Facies " means the expression of the countenance. You have flushed cheeks, herpes labialis, etc. What do you find on palpation?

Ans.: Increased vocal fremitus.

Dr. L.: In lobar pneumonia, you find this over a large area; but in bronchopneumonia, only over small ones. It is the same with dulness on percussion. This is found over a large area in lobar pneumonia, but over smaller areas in bronchopneumonia. You also find the auscultatory phenomena over a large area in lobar, and over small, scattered areas in bronchopneumonia.

Pneumonia, as I have stated, is the chief complication of influenza. Next to this in importance is nephritis. In a great many of my cases in children, I have had the urine examined, and have invariably found albumin present. This shows the existence of an acute tubular nephritis, due to the toxic degeneration going on.

Pleurisy is another complication, and still another bad one is empyema. The latter does not usually follow immediately upon the attack of influenza. It is commonly seen later on. Sometimes, however, it is noticed during the attack.

Student: Do all the respiratory signs disappear after influenza before the empyema develops?

Dr. L.: Not necessarily. This is how it usually happens. The child is recovering from the influenza, and is apparently well. Then he gets up, runs around, and is allowed to have food. If he then again develops a fever, pneumonia invariably follows such a course. The relapses are the dangerous things in influenza, and they are very common. When a relapse occurs, it usually goes into a pneumania. This runs a certain course. The temperature then drops and becomes apparently normal, but it soon shoots up again and becomes irregular. When this happens, you must think of empyema; or the pneumonia may run along after the time when the crisis should have occurred. When should you have the crisis?

Ans.: On the seventh day.

Dr. L.: On the seventh, ninth, or eleventh day. When the eleventh, twelfth and thirteenth day pass, and you still have no crisis, and the temperature remains high, you should begin to think of empyema.

Another complication in children is cervical adenitis. What is cervical adenitis?

Ans.: Adenitis in connection with the cervical glands.

Dr. L.: How many forms of this condition do you know?

Ans.: Mixed, simple, tubercular, syphilitic, and ordinary cervical adenitis.

Dr. L.: There is also a cervical adenitis in connection with Hodgkin's disease. There are four forms to be differentiated. You get a history of influenza. The child has become quite well again, and then develops a cervical adenitis. What is adenitis?

Ans.: Inflammation of the lymph-glands.

Dr. L.: What is the duty of the lymph-glands?

Ans.: To carry off waste products and bring fresh secretions to the body.

Dr. L.: If there is any poison present, each gland tries to take a big load away. The glands enlarge, but they remove the poison; and then the enlargement subsides. Suppose, however, that the load of poisonous material is too great. The glands then break down under the strain and become inflamed and they call on their fellow-glands to help them. The latter try to do so, but sometimes cannot succeed. Then the entire chain of glands becomes involved, and you have a cervical adenitis. Cervical adenitis may sometimes be due to pediculosis capitis.

Tracheitis, bronchitis and bronchiectasis are other complications. Another complication consists in defective areas over the base of the lung, causing one to think of tuberculosis. These have been found in children, as well as in adults. In order to exclude tuberculosis, one should make frequent examinations of the lungs and of the sputum, and should employ the X-ray. These areas are caused by residue left in the lungs, and are persistent and deep-seated.

Tuberculosis is still another complication to consider. In addition to those mentioned, you have to think of nervous complications. They are not common, but there have been cases of psychosis, palsy and neuralgia reported after influenza. I would also mention influenzal meningitis and lethargic encephalitis. Asthenia is another complication that may be present. What is asthenia?

Ans.: Absence of life or power.

Dr. L.: Yes, lack of " pep," as we say. This complication shows that influenza is a general toxic condition, a profound toxæmia.

Unresolved pneumonia is another complication. I saw a case of this kind, and thought at first that it was one of empyema. I tried to aspirate the pus, but found none. It was really a case of unresolved pneumonia, and the child is now getting on nicely. I saw some similar cases in the Polyclinic Hospital last year, and suggested the use of the X-ray, which produced results. Hydriodic acid in large doses proved its value in these cases.

Another complication is susceptibility to colds. As soon as these children catch cold, they have fever, chills and cough, which are probably due to asthenia.

Heart complications form another group to be thought of. Myo-

carditis, tachycardia and bradycardia have followed influenza. Neuralgias have also been present.

In children, one must remember that gastro-intestinal conditions are common. Otitis media is also one of the commonest complications in children. I find an exceptionally large number at present. What is otitis media?

Ans.: Inflammation of the middle ear.

Dr. L.: How would you recognize it in an infant or young child? (No reply.) By looking into the ear whenever there is present a temperature that you cannot account for. Otitis may, however, exist without temperature. In the case of children, therefore, it is your duty to look into the ear routinely. I make it a rule to carry with me a set of three-in-one speculums, a candle and other ordinary appliances for use in this procedure. In case there should be no better ones at hand, or if the battery should be low in my otoscope, I use the candle and head-mirror.

Another condition that I noticed last year was spasmodic croup. I saw two cases in the Polyclinic Hospital. A tracheotomy was performed in one case, and the child died. In the other, we let the child alone, and that patient died also. In a recent case, I called in a laryngologist, who made an examination and said that there was no membrane present. The child made a recovery after the specialist's direct application. In case of spasmodic croup, what should you think of at once?

Ans.: Diphtheria.

Dr. L.: Laryngeal diphtheria. What else? You might have true or false croup, and you might have ordinary laryngitis.

Ques.: What about laryngismus stridulus?

Dr. L.: I have not noticed that as an ordinary complication in influenza. Another complication is retention of urine. What is that?

Ans.: The passing of very small quantities of urine.

Dr. L.: What is the cause of that?

Ans.: The kidneys do not secrete the urine.

Dr. L.: No; the urine is being secreted, but not being passed out. Where is the trouble when only small quantities of urine are passed?

Ans.: In the epididymis or prostate.

Dr. L.: No. Why should the trouble be there? The trouble is in the kidneys. What is incontinence? The patient cannot retain his

urine. Suppression means inability to manufacture urine in the kidneys. In suppression, the trouble is in the kidneys; in incontinence, it is somewhere along the course of the urinary tract from the bladder outward. In retention, in which the urine stays in the bladder, the trouble seems to be in the bladder itself, which is not able to urge an outflow. It is usually a nervous condition.

You may expect any complication in influenza, because it is such a terribly mixed infection. We did not elaborate on the symptoms so much as we should have done, but we can take them up more in detail at some other time.

What are the two divisions in the treatment of influenza?

Ans.: Prophylaxis and active treatment.

Dr. L.: What is the prophylaxis in this condition?

Ans.: The prevention of exposure.

Dr. L.: You should isolate the patient, and try to keep the rest of the family in good condition. See that the house is well aired, and have the other members of the family keep their nose, mouth and throat clean by spraying and gargling. See that their bowels are in good condition. Keep up their resistance.

Under the heading of active treatment, the first thing to consider is the room temperature. That is most important. The fewer drugs you give children, the better. Remove every source of irritation, and have the air in the room fresh, but warm. It should be about 60° F., and not lower than 40° F.

The next thing to be thought of is general elimination. What should you do to accomplish this?

Ans.: Give calomel and sodium bicarbonate.

Dr. L.: How much?

Ans.: One-tenth of a grain of calomel with one grain of bicarbonate of soda, in ten doses, the last dose being followed by a purge, such as magnesium sulphate, milk of magnesia, effervescent magnesium citrate, castor oil, etc.

Dr. L.: Would you give magnesium sulphate to your own child?

Ans.: No.

Dr. L.: Then you should not give it to other people's children, especially when you can give effervescent magnesium citrate, one ounce every hour until you get a good bowel movement. You can

also give castor oil or milk of magnesia; or, to obtain quick action, you may order a colonic irrigation.

The actual treatment of influenza is supportive, eliminative and symptomatic. There is no specific for the disease. The diet should be light, nutritious and perfectly liquid; but if the child is old enough, a semi-solid diet may be given—soups or broths, cereals and milk-toast. In the absence of nephritis, the child may have an egg once a day. Nourishing food is very important, because it is supportive. Toxæmia will weaken the patient, and it is necessary to keep up his strength.

Plenty of orange juice should also be given. It is a diuretic, and is supposed to become alkaline after entering the stomach. If it constipates the child, you can prevent that condition. You may also give lemonade, one teaspoonful of cream of tartar being added to every pint. This will overcome the sharp, acid taste of the lemonade and prevent the necessity of adding so much sugar, which is inadvisable. In addition to these, you must be sure that plenty of drinking water is administered.

Small doses of aspirin may be given. The teaching has been against the administration of aspirin in the case of adults; but I find that a small dose of this, from half a grain to a grain every four hours, is not a bad thing for a child. You can also give bromides for the headache, and can resort to hydrotherapy, sponging the patient; and it is sometimes wise to let the patient alone for a while. Personally, I do not think that vaccines are of much account. My observations in a case of influenzal pneumonia seen with Doctor Robertson, however, were very favorable to this form of treatment. This patient, within twenty minutes after the injection, developed a chill, which lasted nearly forty minutes; and the temperature went up to 107.6°. A little later, however, it suddenly dropped, and remained down, and the patient made an early and complete recovery. Small doses of codeine may be administered, in preference to morphine. Why? Because morphine dries up the secretions, with the result that the kidneys are overworked. For the same reason, you should not prescribe belladonna in lung conditions; because belladonna, or atropine, dries up the secretions also.

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